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REVISION OF THE NORTHEAST ATLANTIC BATHYAL AND ABYSSAL MESOGASTROPODA

PHILIPPE BOUCHET
Muséum National d'Histoire Naturelle, Paris
and
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Naturhistoriska Riksmuseet, Stockholm

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This paper constitutes the fourth part of a monograph of the northeast Atlantic bathyal and abyssal gastropods. Page and figure numbers in this volume follow numbers in the preceding volumes.

Part 1, covering the family Turridae, was published in *Journal of Molluscan Studies*, supplement 8 (1980).

Part 2, covering the Neogastropoda excluding Turridae, was published in *Bollettino Malacologico*, supplement 1 (1985).

Part 3, covering the families Aclididae, Eulimidae and Epitoniidae, was published in *Bollettino Malacologico*, supplement 2 (1986).

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ABSTRACT

This monograph concludes the revision of the deep-sea caenogastropods from the northeast Atlantic. The area surveyed covers the Atlantic north of 30° N, east of the Mid-Atlantic Ridge, including the Mediterranean and the Norwegian Sea. Previously described material from 'historical' expeditions is revised, and new material from recent deep-sea programs is studied.

A total of 107 valid species are treated. The taxonomy, nomenclature and distribution of each species is considered, and new information about the biology is presented.

New genera: *Ektonos* (Cerithiopsidae), *Gofasia* (Rissoidae), *Calyptoconcha* (Lamellariidae). The genera *Krachia* Baluk, 1975 and *Onchodia* Dall, 1924 are recognized for the first time in the European fauna.

New species: *Strobiligera lubrica, S. flammulata* (Triphoridae), *Alvania adinogramma, A. cancapae, A. adiaphoros, A. stenolopha, Frigidoalvania thalassae, Crisilla amphiglypha, Gofasia vanderlandi, G. galiciae, G. josephinae, Pusillina hadra, P. metivieri, Benthonellania oligostigma, B. agastachys, Pseudosetia amydralox, P. azorica* (Rissoidae), *Torellia didyma* (Capulidae), *Lunatia talismani, Polinices presubplicata* (Naticidae).

New synonyms: *Neojanacus* Suter, 1907 is synonymized with *Leptonotis* Conrad, 1866, and transferred from Capulidae to Hipponicidae. Numerous new specific synonymies are established or confirmed, based on examination of type and additional material.

RIASSUNTO

La presente revisione dei Gasteropodi di profondità dell'Atlantico nordorientale fa seguito ai tre contributi sull'argomento pubblicati dal 1980 al 1986. Questa quarta parte comprende le (super)famiglie Cerithioidea, Rissooidea, Aporrhaidae, Vanikoroidea, Capuloidea, Ovulidae, Naticidae e Tonnoidea e completa la revisione dei Caenogastropoda. La regione studiata comprende essenzialmente l'Atlantico settentrionale a Nord del 30° parallelo e a Est della dorsale medio-oceanica, includendo il Mediterraneo e il mare di Norvegia. Sono prese in esame solo quelle specie la cui distribuzione è essenzialmente batiale o abissale.

La revisione si basa sul riesame critico delle collezioni effettuate nell'ambito di campagne oceanografiche 'storiche' nonchè su materiali acquisiti più di recente da numerosi programmi nazionali relativi allo studio del benthos profondo.

Per quanto riguarda la sistematica e nomenclatura delle specie mediterranee, i risultati principali sono i seguenti:

1. *Cerithiella metula* (Lovén, 1846) [= *C. hanleyana* Monterosato, 1884 *nom. nud.* = *C. macrocephala* Dautzenberg & Fischer, 1897] è l'unico Cerithiopsidae batiale del Mediterraneo. *Eumetula aliceae* (Dautzenberg & Fischer, 1896) è segnalata per un giacimento quaternario italiano. *Cerithiopsis valeriae* Giusti, 1987 viene trasferito nel genere *Onchodia* Dall, 1924. *Strobiligera* sp.A (Bouchet 1985) viene nominata *S. flammulata* sp.n.
   Bittium watsoni (Jeffreys, 1885) non penetra in Mediterraneo.
2. *Alvania electa* (Monterosato, 1874) è il nome valido per la specie finora denominata *A. deliciosa* (Jeffreys, 1884). *Alvania tomentosa* (Pallary, 1920) [= *A. altenai* van Aartsen, Menkhorst & Gittenberger, 1984] è riconosciuta come specie valida del circalitorale profondo e della scarpata continentale.
   Pseudosetia ficaratiensis (Brugnone, 1876), descritta come fossile plio-pleistocenico della Sicilia, è segnalata vivente nello stretto di Gibilterra e nel golfo ibero-marocchino. *P. turgida* (Jeffreys, 1870) è specie strettamente atlantica che non entra in Mediterraneo.
   L'unica specie mediterranea di *Benthonella* è *B. tenella* (Jeffreys, 1869).
3. *Torellia vestita* Jeffreys, 1867 è sinonimo di *T. delicata* (Philippi, 1844) ed è quest'ultimo nome che deve essere utilizzato per questo Capulidae settentrionale segnalato nel Quaternario del bacino del Mediterraneo.

4. *Cryptonatica affinis* (Gmelin, 1791) non vive in Mediterraneo. E specificamente distinta dalla *C. operculata* (Jeffreys, 1885), seppure rinvenuta finora solo in tanatocenosi del bacino occidentale.
   Natica settepassii Gaglini *in* Settepassi, 1985, è messa in sinonimia di *Tectonatica rizzae* (Philippi, 1844) [= *N. pyrrhosticta* Dautzenberg & Fischer, 1896].
   Natica globosa Jeffreys, 1885 è una larva di Cassidae.
5. Il genere *Oocorys* non penetra in Mediterraneo. *"Oocorys" solidior* (Dautzenberg & Fischer, 1906) è sinonimo di *Eudolium bairdii* e *Oocorys alboranensis* Settepassi, 1971 è posto in sinonimia di *Galeodea echinophora*.
6. Per la specie finora conosciuta come *Galeodea tyrrhena* va considerato valido il nome *G. rugosa* (Linné, 1767). Le conchiglie ascritte a *Entoconcha mirabilis* dalla letteratura italiana recente sono invece delle protoconche di *Galeodea*.
7. *Eudolium crosseanum* (Monterosato, 1869) e *E. bairdii* (Verrill & Smith, 1881) [= *E. solidior*] sono due specie distinte, entrambe riportate per il Mediterraneo dove rappresentano probabilmente solo delle pseudopopolazioni.

INTRODUCTION

This volume concludes the revision of the Northeast Atlantic bathyal and abyssal mesogastropods. The families Aclididae, Eulimidae and Epitoniidae were treated in part 3 (p. 297-576). The present volume thus covers a heterogeneous assortment of families and superfamilies, many of which are represented in the Northeast Atlantic deep sea by a single species or a single genus. The taxonomy and relationships of the Haloceratidae and the Tonnoidea have been discussed on a world-wide scale in separate papers (Warén & Bouchet 1990, 1991). The more species-rich families Cerithiopsidae, Rissoidae and Naticidae require similar treatment but, considering the size of these families, we have had to address the generic classification mostly at a regional scale (the North Atlantic). The classification achieved is thus far from final in many instances.

As for earlier parts in this series, our work is based on all available deep-sea gastropod material from the Northeast Atlantic and adjacent basins (the Arctic Basin, the Norwegian Sea, the Mediterranean). Historical expeditions have been ennumerated pages 1-3, and the repositories of the material indicated. New material has regularly become available as a result of ongoing research programs in various European countries. This material, its origin and repositories is listed in the introductions to parts 2 (p. 125) and 3 (p. 301). Accounts of deep-sea biological work in the Bay of Biscay and Porcupine Seabight have been presented by Laubier & Monniot (1985) and Rice *et al.* (1991) respectively.

In addition to this, material has also been examined from the following sources:
(1) BIOFAR. A joint Nordic program for the exploration of the marine fauna around the Faroes. 712 stations investigated 1987-1990, mainly in the depth range 100-1200 m. Material mainly at the Marine Biological Laboratory, Kaldbak, the Faroes.
(2) The SEAMOUNT 1 Expedition conducted in 1987 on board RV Noroit on the banks off the Iberian peninsula: a total of 92 dredgings and trawlings were made on the Galicia, Gorringe, Josephine, Seine and Ampère Banks. The material has been processed by ZOOTAX (Stockholm) and CENTOB (Brest), and the resulting material is deposited in MNHN and SMNH.
(3) Mollusc material from around Iceland has been examined by A. Warén in Icelandic private collections. New species and new records have been reported in separate papers (Warén 1989a, 1991), and the deep-sea data are summarized here where appropriate. Voucher specimens of this material are now in SMNH.

Altogether more than 450 species of gastropods have now been covered in this series. We have however decided to postpone general discussions on faunal composition, depth-related gradients and biogeography until the rest of the gastropods has been monographed. The Archaeogastropoda and the Opisthobranchia will be monographed in parts 5 and 6 respectively.

Family CERITHIIDAE

The family Cerithiidae is predominantly a shallow water family, but a number of genera and species occur on the upper part of the continental slope in tropical regions (see e.g. Houbrick 1980a, 1980b, 1981). A single species deep-water species occurs moderate depths in the northeastern Atlantic.

We have included this species in the identification key at page 587 since cerithiids and cerithiopsids are not always easy to tell apart.

Genus *BITTIUM* Leach *in* Gray, 1847

Bittium Leach *in* Gray, 1847a:270. Type species, by subsequent designation (Gray 1847b:154) *Bittium reticulatum* (da Costa, 1778), Europe.

Remarks: Pending work in progress by R. Houbrick and W. Ponder (pers. comm.) on the classification of the small cerithioids, we keep *Cerithium watsoni* in *Bittium*, where Sykes (1925) placed it. Despite a superficial resemblance to *Argyropeza* (see Houbrick 1980a), *B. watsoni* intuitively appears more closely related to the European shallow water species of *Bittium*. For a review and list of generic synonyms, see Houbrick (1977).

Bittium watsoni (Jeffreys, 1885) Figs 1268-1272, 1277, 1286

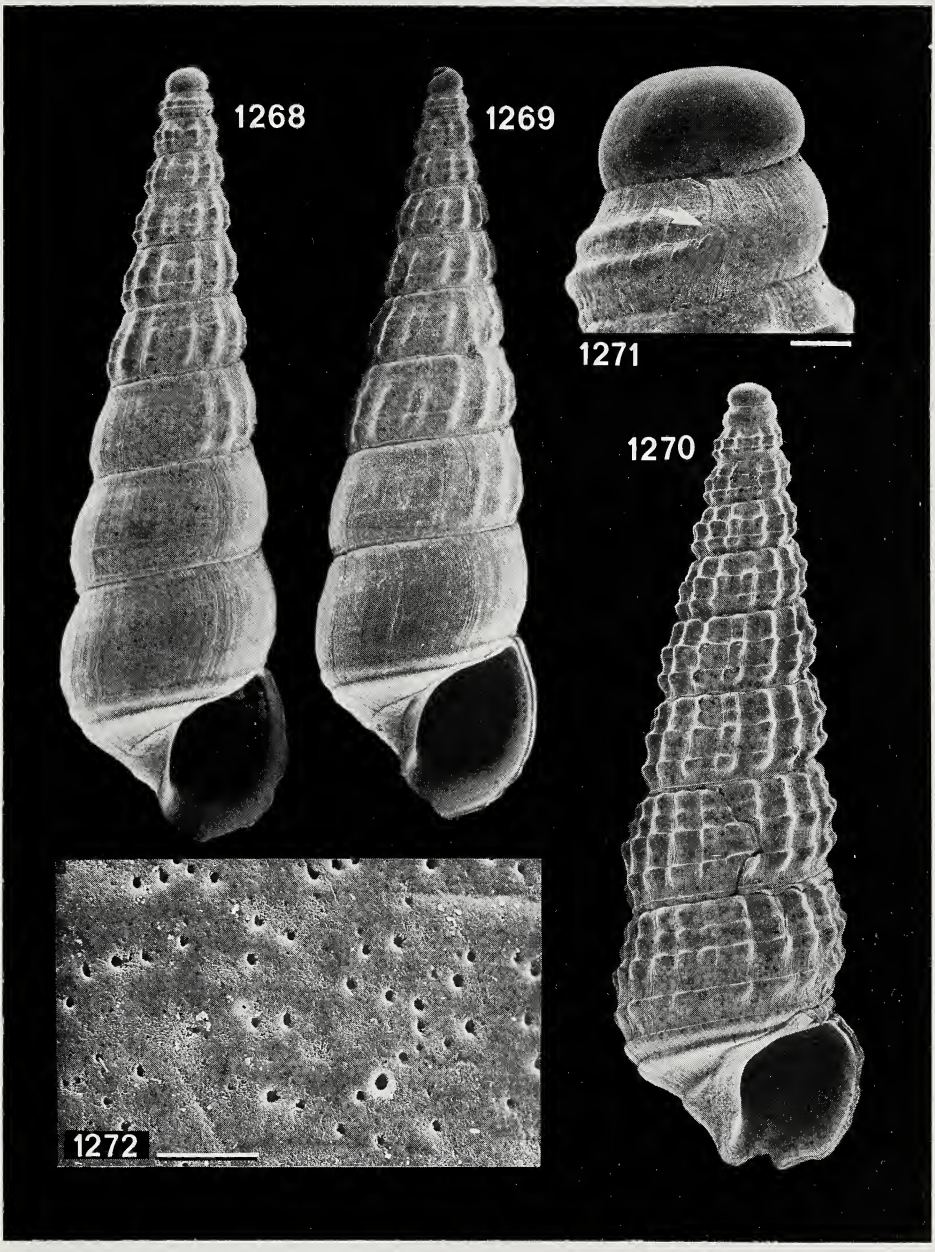
Cerithium gemmatum Watson, 1880:113 (not *C. gemmatum* Hinds, 1844).
Cerithium watsoni Jeffreys, 1885:56, pl. 6 figs 6-6a, *nom. nov.* for *C. gemmatum* Watson.
Bittium watsoni var. *dissimilis* (Marshall ms.) Sykes, 1925:185.

Type material: 4 syntypes BMNH 1887.2.9.1702-1705.

Type locality. Off Portugal, CHALLENGER st 11, 38°10' N, 09°14' W, 865 m.

Material examined: The type material and --

-Off the Iberian Peninsula: MONACO Exp st 66, 43°12' N, 09°31' W, 363 m, 1 sh; THALASSA st Y400, 40°46' N, 09°19' W, 800 m, 4 shs; JOSEPHINE Exp 1869, 38°07' N, 09°18' W, 1010-1455 m, 18 spms+shs; JOSEPHINE Exp 1869, 1438 m, 1 sh (USNM 187646); PORCUPINE 1870 st 17, 39°42' N, 09°43' W, 1092-1993 m, 16 shs; st Setubal Bay, 116 m, 16 shs (USNM 187635); st 24, 37°19' N, 09°13' W, 535 m, 55 shs (BMNH; USNM 187636); st 26, 36°44' N, 08°08' W, 665 m, 17 shs (USNM 187637); st 27, 36°37' N, 07°33' W, 590 m, 100 shs (USNM 187638); st 28a, 525 m, 100++ shs (USNM 187640); st 29, 36°20' N, 06°47' W, 415 m, 29 shs (USNM 187642); st 30, 36°15' N, 06°52' W, 710 m, 132 shs (BMNH); st 34, 35°44' N, 06°53' W, 760 m, 20 shs (USNM 187643); st 36, 35°35' N, 06°26' W, 132-235 m, 9 shs (USNM 187644); mixed stations, 5 lots, 35 shs (BMNH); BALGIM st CP3, 36°50' N, 09°14' W, 678-684 m, 1 worn sh; st DW20, 36°36' N, 07°24' W, 450-454 m, 3 spms, 5 shs; st DR22, 36°35' N, 07°24' W, 462-472 m, 33 shs; st DR23, 36°39' N, 07°19' W, 556 m, 4 shs; st DW24, 36°41' N, 07°19' W, 543-546 m, 1 sh; st CP25, 36°41' N, 07°19' W, 543 m, 1 sh; st DR37, 36°18' N, 07°15' W, 860-868 m, 1 sh; st CP155, 36°20' N, 07°41' W, 903 m, 10 shs.



Figures 1268-1272. *Bittium watsoni.* **1268,** BALGIM st DR82, 6.5 mm. **1269-1270**, BALGIM st DW57, 7.0 mm and 6.5 mm. **1271**, protoconch, BALGIM st DR82, scale line 100 μm. The arrow indicates the protoconch - teleoconch demarcation. **1272**, microsculpture, BALGIM st DW57, scale line 10 μm.

-Off northwestern Africa: -TRAVAILLEUR 1881 dr 30, 35°25' N, 08°00' W, 1205 m, 5 worn shs; TALISMAN dr 17 and 24 (mixed lot), 33°33' N, 08°59' W, 550 m and 33°14' N, 08°54' W, 120 m, 1 spm, 16 shs (MNHN, USNM 187645); BALGIM st DR40, 35°50' N, 06°09' W, 362 m, 25 shs; st DR45, 35°44' N, 06°17' W, 293 m, 7 shs; st DR49, 35°53' N, 06°33' W, 518-524 m, 9 worn shs; st DW50, 35°53' N, 06°32' W, 518-526 m, 6 shs; st DR75, 33°53' N, 08°15' W, 252 m, 5 spms, 2 shs; st DR79, 33°49' N, 08°24' W, 255-267 m, 6 shs; st DR81, 33°46' N, 08°30' W, 309 m, 5 shs, 19 spms; st DR82, 33°45' N, 08°32' W, 355 m, 51 spms; st DR101, 34°11' N, 07°30' W, 353 m, 1 spm; st DR115, 35°47' N, 06°04' W, 332 m, 6 shs; CANCAP st 2.058, 27°58' N, 13°24' W, 500 m, 20 shs; DISCOVERY st 7851, 25°44' N, 15°48' W, 486-559 m, 2 shs; off SW Gorée, Senegal, 150-250 m, 1 sh (MNHN, leg. Marche-Marchad).

Distribution: From northwestern Spain to Senegal, in ca. 200-1200 m. It is rather common on the deep shelf and upper slope of the Ibero-Moroccan Gulf but does not occur on the banks off the Iberian peninsula.

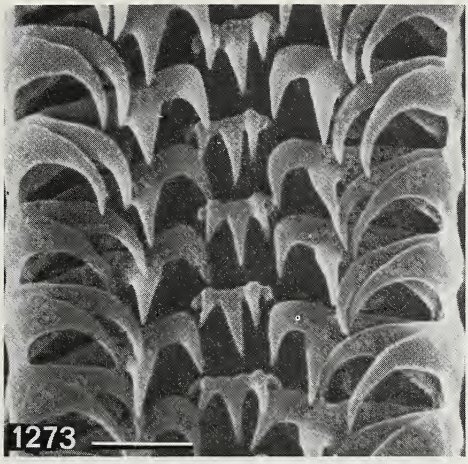
Remarks: Dautzenberg's (1889) record from the Azores is erroneous and was based on *Triforis* sp. Sykes (1925:185) listed also st 50, off Algeria, among the PORCUPINE stations where *B. watsoni* was present. We have examined this sample, consisting of 2 shells, in BMNH and can confirm the identification. However the collections of station 50 were done in a depth of 10-94 m, which means a different faunal zone from all the Atlantic stations listed above. *Bittium watsoni* was neither taken by the BALGIM expedition which dredged extensively in the right depths in the Alboran Sea, nor has it been recoded from there by any other author. We therefore believe that the PORCUPINE material has been mislabelled and that *B. watsoni* does not occur in the Mediterranean.

Family CERITHIOPSIDAE

A world wide survey over the bathyal and abyssal cerithiopsids (Bouchet & Warén in prep.) has revealed many problems in the present classification of the cerithiellids, cerithiopsids, triforids etc. We therefore leave the suprageneric classification to be discussed in connexion with the results of that work and retain here a conservative placement of all the European species in the Cerithiopsidae. It should be noted that *Cerithiella, Eumetula* and *Laiocochlis* have been made the type genera of the family-group names Cerithiellidae [= Newtoniellinae], Eumetulinae and Laiocochlinae.

Cerithiopsids are not common deeper than 100-200 m, a marked contrast to the intertidal and shelf fauna of southern Europe, which contains more than 10 genera and 25 species of Cerithiopsidae s.str. (unpublished). Below this depth, the typical cerithiopsids are replaced by a few species of *Cerithiella, Eumetula*, and similar genera.

Figures 1273-1277. Radulae. **1273,** *Cerithiella insignis*, BALGIM st DW74. **1274,** *Cerithiella metula* form *danielsseni*, Norwegian Sea. **1275,** *Cerithiella metula*, "normal" form, Bergen area. **1276,** *Cerithiella metula*, INCAL st DS9, radula of embryo dissected out from egg capsule (see figs 1317-1318), total length of ribbon 80 μm. **1277,** *Bittium watsoni*, off Portugal, 590 m.
Scale lines 20 μm (1277), 10 μm (1273-75), 5 μm (1276).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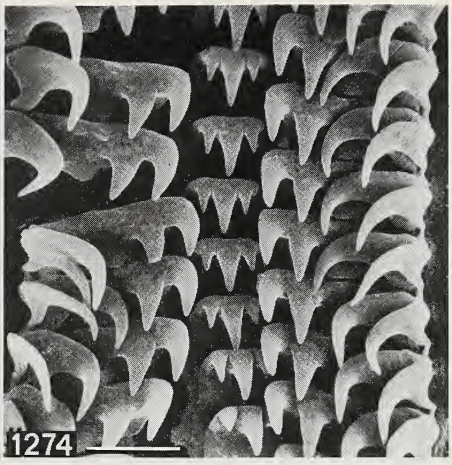
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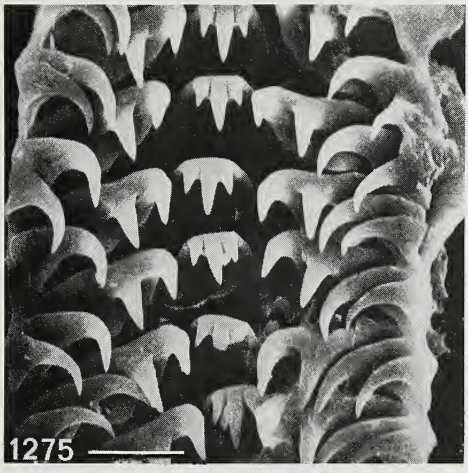
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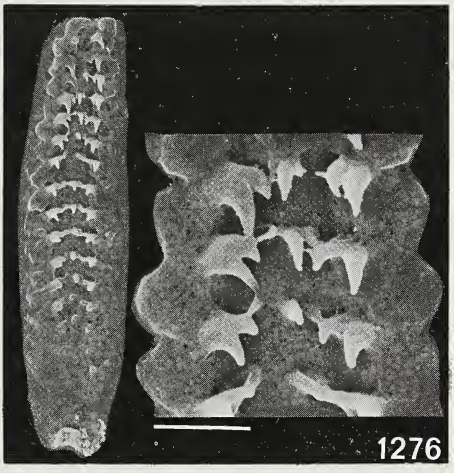
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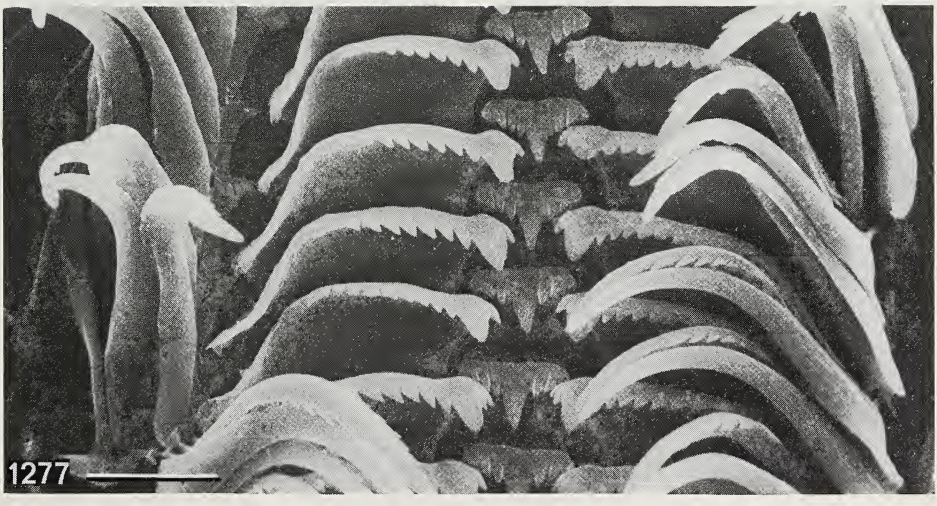
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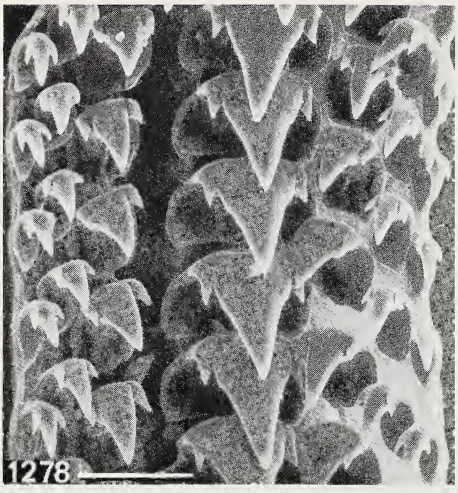
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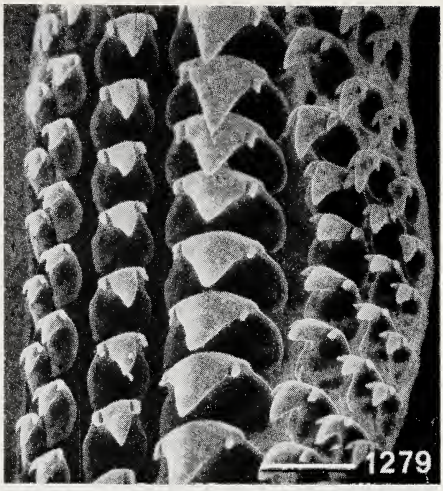
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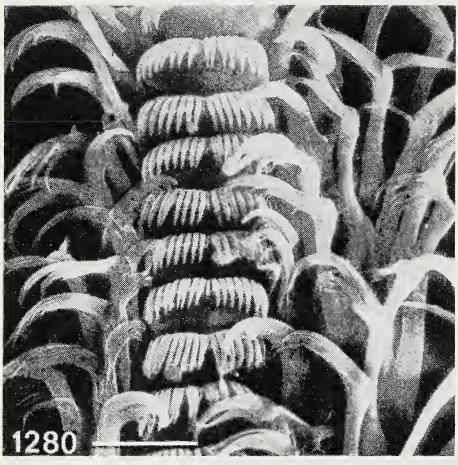
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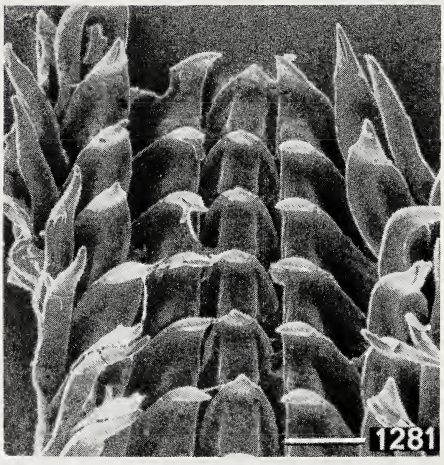
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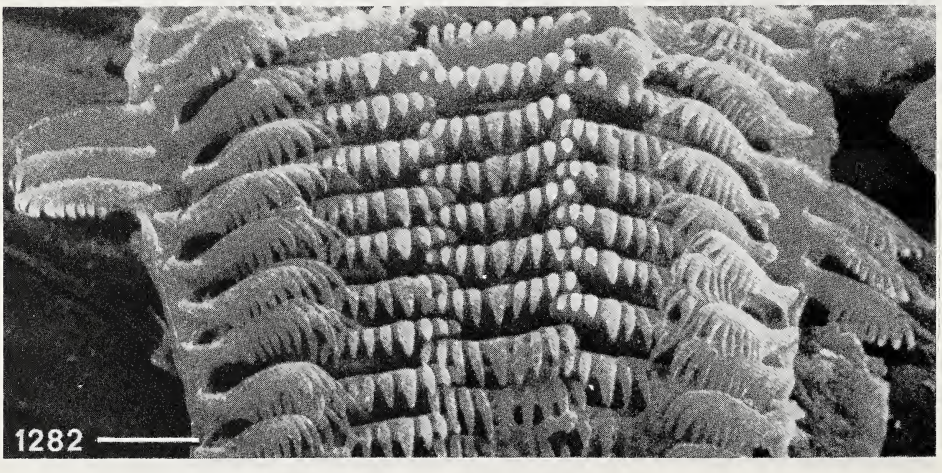

1282

KEY TO THE GENERA OF CERITHIOIDEA

A. Shell sinistral ..... B
A. Shell dextral C

B. Sculpture of 5 undulating spiral cords, protoconch paucispiral ..... *Laiocochlis* (p. 614)
B. Sculpture of 2-3 knobby spiral cords, protoconch multispiral ..... *Strobiligera* (p. 617)

C. Siphonal notch not drawn out into a siphonal canal ..... D
C. Distinctly drawn out siphonal canal ..... F

D. Adult shell large, over 15 mm ..... *Ektonos* (p. 608)
D. Adult shell smaller than 10 mm ..... E

E. Periphery with one broad strong cord, and base with one very thin cord ..... *Eumetula* (p. 601)
E. Periphery with two strong, base with one smooth, broad cord ..... *Bittium* (p. 582)

F. Base of shell with several spiral cords below periphery ..... *Onchodia* (p. 610)
F. Base of shell smooth below peripheral cords ..... G

G. Two smooth cords at periphery of body-whorl ..... *Krachia* (p. 605)
G. One smooth cord at periphery ..... H

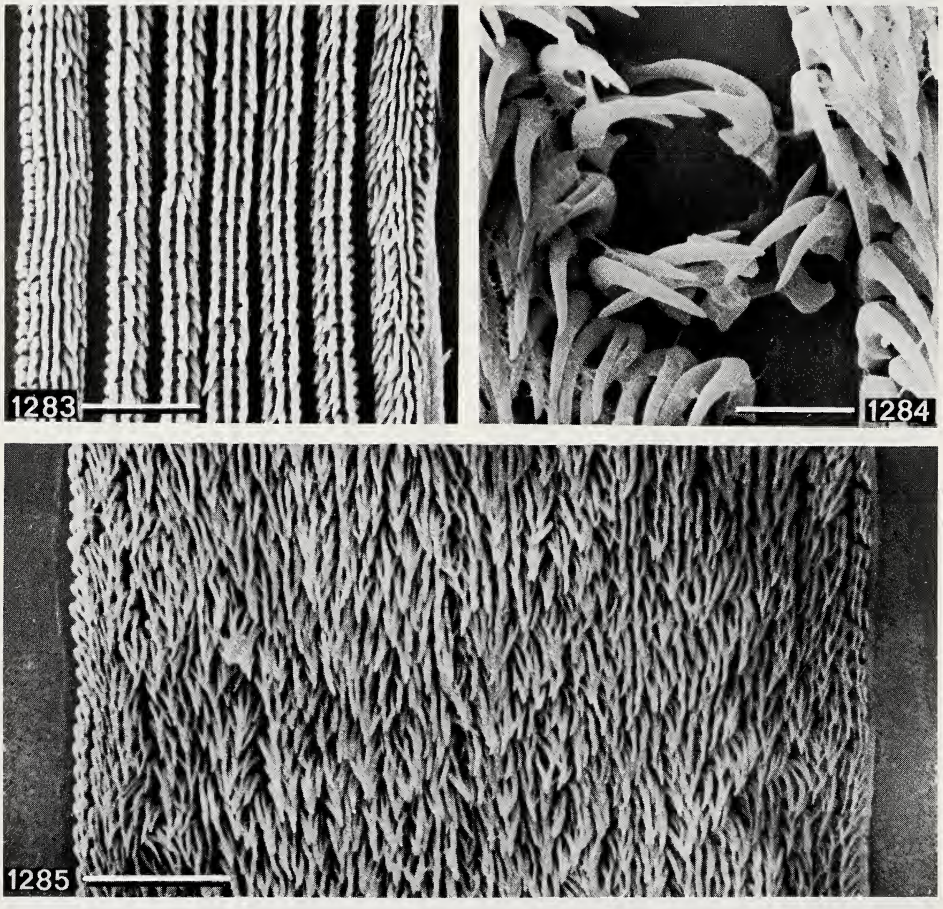
H. Shell reddish brown, protoconch multispiral ..... *"Cerithiopsis"* (p. 612)
H. Shell whitish, sometimes with greenish periostracum, protoconch paucispiral ..... *Cerithiella* (p. 588)

Figures 1278-1282. Radulae. **1278-1279,** *Ektonos turbonilloides*, CHALLENGER 2 st 177. **1280,** *Krachia cossmanni*, Bergen area. **1281,** *Laiocochlis sinistrata*, Bergen area. **1282,** *Eumetula arctica*, Bergen area.

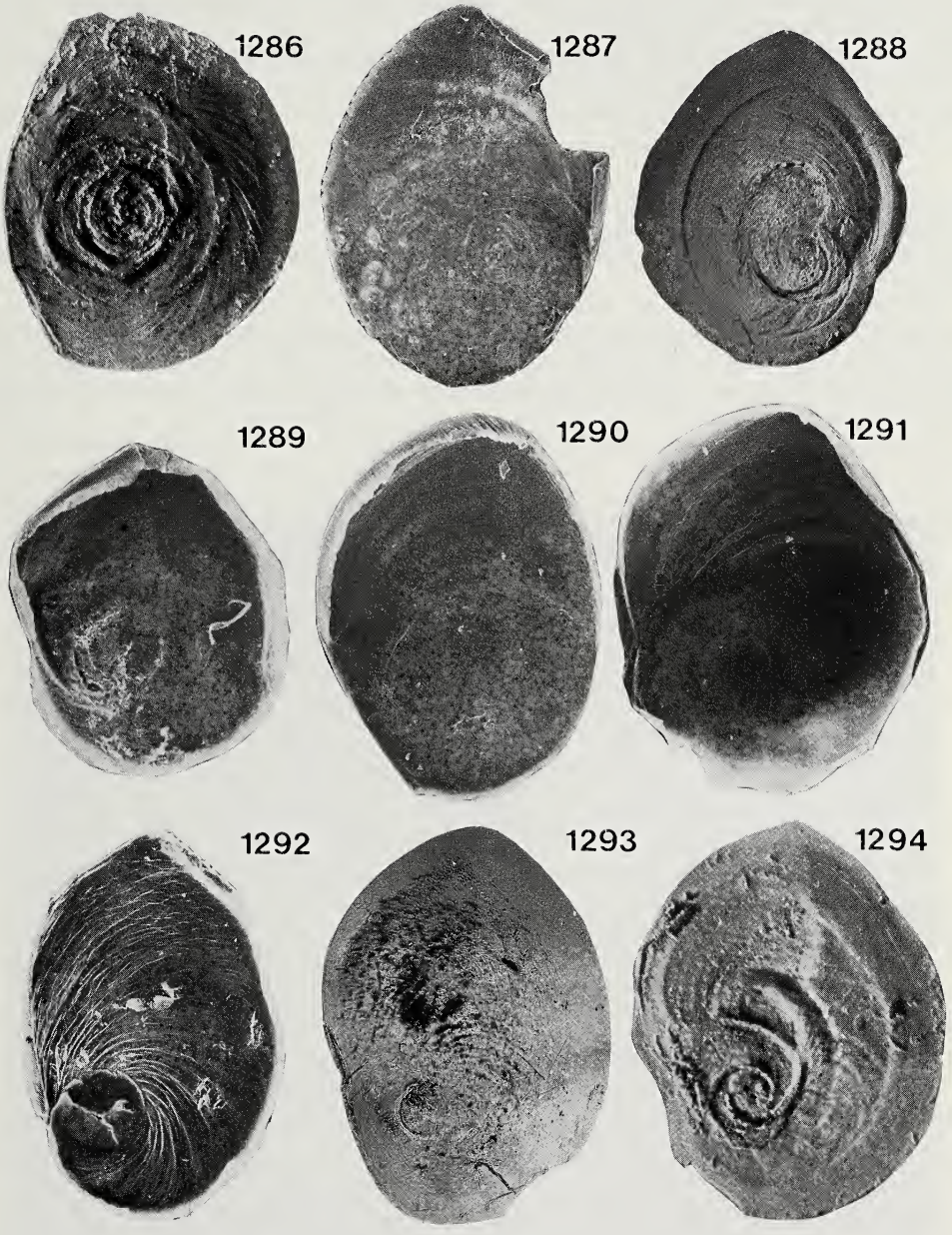
Scale lines 100 μm (1281), 50 μm (1278-79), 10 μm (1280, 1282).

Genus *CERITHIELLA* Verrill, 1882

Lovenella G.O. Sars, 1878:187 (not *Lovenella* Hincks, 1869). Type species, by original designation, *Cerithium metula* Lovén, 1846. Europe.
Cerithiella Verrill, 1882:522 (*nom. nov.* for *Lovenella* Sars, 1878).
Stilus Jeffreys, 1885:52. Type species, by monotypy, *S. insignis* Jeffreys, 1885. Northeastern Atlantic. (***Syn. nov.***)
Newtonia Cossmann, 1893a (April):721 (not *Newtonia* Schlegel, 1867) (*nom. nov.* for *Lovenella* Sars, 1878).



Figures 1283-1285. Radulae. **1283,** *Onchodia valeriae*, BALGIM st DW50. **1284-1285,** *Strobiligera lubrica*, holotype.
Scale lines 20 μm (1285), 10 μm (1283), 5 μm (1284).



Figures 1286-1294. Opercula. **1286,** *Bittium watsoni*, off Portugal, 590 m, 1.2 mm. **1287,** *Strobiligera lubrica*, holotype, 1.8 mm. **1288,** *Laiocochlis sinistrata*, Bredefjord, Norway, 4.5 mm. **1289,** *Krachia cossmanni*, Bergen area, 0.7 mm. **1290,** *Onchodia valeriae*, BALGIM st DW50, 0.7 mm. **1291,** *Cerithiella insignis*, BALGIM st DW74, 0.3 mm. **1292,** *Eumetula arctica*, Bergen area, 1.1 mm. **1293,** *Ektonos turbonilloides*, Rockall Trough, 1.8 mm. **1294,** *Cerithiella metula*, Bergen area, 0.8 mm.

Newtoniella Cossmann, 1893b:18 (*nom. nov.* for *Newtonia* Cossmann, 1893).
Cerithiolinum Locard, 1903:110 (*nom. nov.* for *Lovenella* Sars, 1878).
Chasteria Iredale, 1915:334. Type species, by original designation, *Cerithium procerum* Jeffreys, 1877. Northeastern Atlantic. (***Syn. nov.***).
Euseila Cotton, 1951:387 (June). Type species, by original designation, *E. pileata* Cotton, 1951. Southern Australia. (***Syn. nov.***)
Binda Laseron, 1951:361 (July). Type species, by original designation, *B. tasmantis* Laseron, 1951. Southeastern Australia. (***Syn. nov.***)

Remarks: Cossmann proposed *Newtonia* because he erroneously considered *Cerithiella* Verrill to be preoccupied by *Ceritella* Lycett, 1850.

Chasteria is here synonymized with *Cerithiella* because we consider their type species to be subjective synonyms.

The type species of *Stilus* has a radula very similar to that of *Cerithiella metula*, and the shells differ only in *Stilus* having a peculiarly pointed and twisted protoconch. Thiele (1929) regarded *Stilus* as a subgenus of *Cerithiella*. We consider the peculiar character of the protoconch, also present in several Australian species, to have evolved several times from species of *Cerithiella* with "normal" protoconchs, and therefore *Stilus* should be considered a synonym (not a subgenus) of *Cerithiella*.

Binda was synonymized with *Euseila* by Marshall (1978:68) who considered their respective type species to be subjective synonyms. Examination of the shell and radula of *E. pileata* (material in AMS) showed no significant difference from *Cerithiella*. The protoconch is somewhat intermediate between the "normal" and *"Stilus"* types, and the shell has a long, twisted siphonal canal. Laseron (1951) had noted the similarity of *Binda* and *Newtoniella* (= *Cerithiella*), but erroneously believed *Newtoniella* to be based on a Cretaceous type species.

Cerithiella metula (Lovén, 1846)
Figs 1274-1276, 1294-1315, 1317-1318

Cerithium metula Lovén, 1846:155.
Cerithium nitidum Forbes, in M'Andrew & Forbes, 1847:97, pl. 9 fig. 2.
Cerithium bicinctum M.Sars, 1859:84 (*nomen nudum*); Jeffreys, 1867:258 (in synonymy) (not *Cerithium bicinctus* Risso, 1826).
Cerithium procerum Jeffreys, 1877:232; Jeffreys 1885:53, pl. 6 figs 2-2a (not *Cerithium procerum* Kiener, 1841-42; nor *C. procerum* Eichwald, 1868).
Lovenella whiteavesii Verrill, 1880a:391, 396; Verrill, 1882:522, pl. 42, fig. 7.
Cerithiella hanleyana Monterosato, 1884:123 (*nom. nud.*).
Cerithium gracile Jeffreys, 1885:54, pl. 6 figs 3-3a (preoccupied 5 times by *Cerithium gracile* Lamarck, 1804; Anton, 1838; Morris, 1854; Sowerby, 1855; Pease, 1860).
Cerithiopsis bizonalis Jeffreys, 1885:62, pl. 6 fig. 10.
Cerithium metulatum Locard, 1886:181 (unjustified emendation of *C. metula*).
Cerithiella macrocephala Dautzenberg & Fischer, 1897:158, pl. 3 fig. 5; Dautzenberg 1927:113, pl. 1 fig. 30.

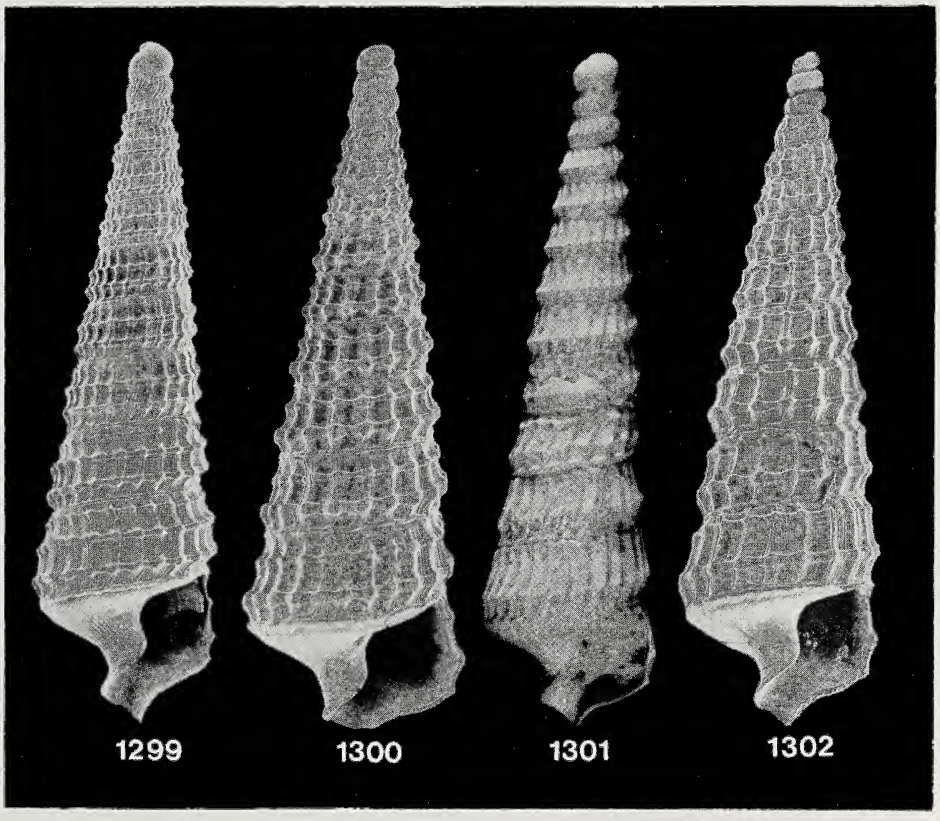
Type materials: C. metula, holotype SMNH 1530; *C. procerum*, syntypes in BMNH and USNM; lectotype here designated USNM 187632; *C. whiteavesii*, 2 syntypes from USFC st 891, USNM 45439, and 2 syntypes from USFC st 894 in National Museum, Ottawa (Johnson 1989:73; not seen); *C. gracile*, holotype BMNH 1885.11.5.2524; *C. bizonalis*, not located; *C. macrocephala*, holotype MOM.

Type localities: C. metula, Bergen, Norway; *C. nitidum*, Ling Bank, Shetland, 90 m; *C. bicinctum*, Mangerfjord, Norway; *C. procerum*, no type locality given, the lectotype is from VALOROUS st 12, 56°11' N, 37°41' W, 2653 m; *C. whiteavesii*, FISH HAWK st 891, 39°46' N, 71°10' W, 915 m and st 894, 39°53' N, 70°58' W, 668 m (off NE United States); *C. gracile*, PORCUPINE 1870 st 3, 51°38' N, 12°50' W, 677-1320 m ("may be erroneous", Warén 1980:25); *C. bizonalis*, PORCUPINE 1870 st 16, 39°55' N, 09°56' W, 1809 m (off Portugal); *C. macrocephala*, MONACO Exp st 719, 39°11' N, 29°06' W, 1600 m (Azores).

Material examined: The type material listed above and

--Scandinavia, Iceland, Norwegian Sea, Greenland: Several hundred specimens and shells of the "shallow water" nominal form from the Norwegian coast in 50-500 m (ZMO, ZMB, SMNH, ZMC, USNM); western and southwestern Iceland, from Vestfjord to Grundavikursjo, 100-300 m, many spms (Hans Larsen, Reykjavik; SMNH).

--"Deep water" (*danielsseni*) form from the following localities: INGOLF st 10, 64°24' N, 28°50' W, 1484 m, 4 shs; st 32, 66°35' N, 56°38' W, 599 m, 2 spms; st 78, 60°37' N, 27°52' W, 1505 m, 1 sh; st 90, 64°45' N, 29°06' W, 1070 m, 1 sh; st 116, 70°05' N, 08°26' W, 699 m, 2 shs; st 117, 69°13' N, 08°23'



Figures 1295-1298. *Cerithiella metula*. **1295**, off Bergen, North of Marsteinen, 300-330 m, 9.0 mm. **1296**, Sicily Channel, 36°17' N, 13°42' E, 600 m, 8.6 mm. **1297**, holotype of *C. macrocephala*, 22.0 mm. **1298**, BIOGAS st CP1, 9.6 mm.

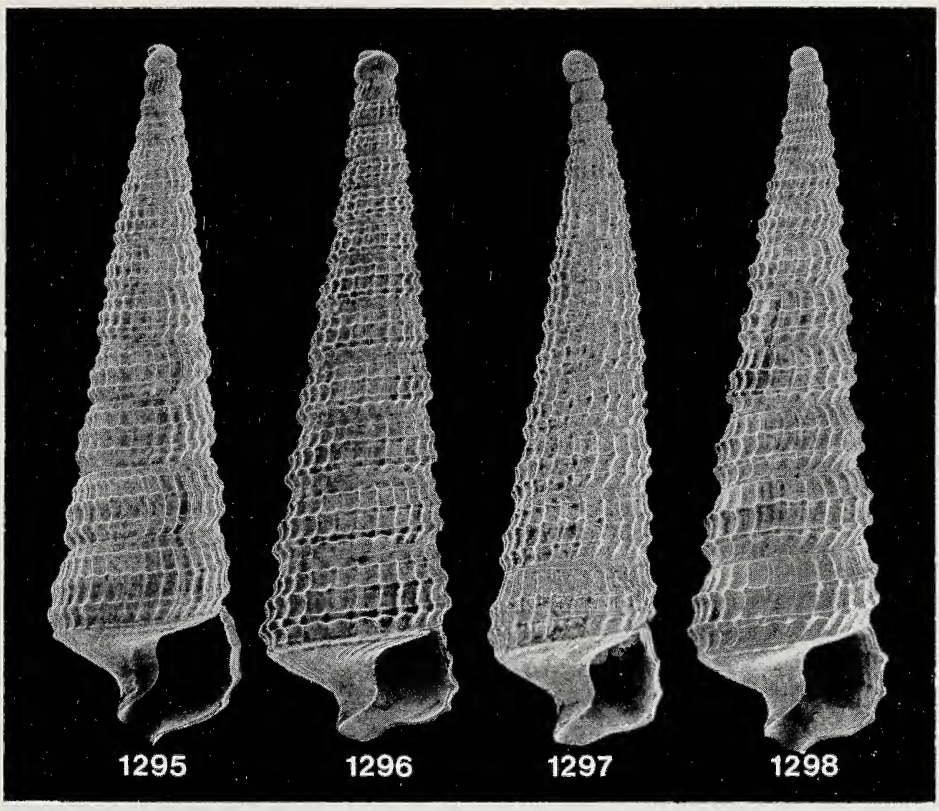
W, 1889 m, 3 spms; st 119, 67°53' N, 10°19' W, 1902 m, 1 sh; st 120, 67°29' N, 11°32' W, 1666 m, 1 sh; st 139, 63°36' N, 07°30' W, 1322 m, 1 sh; TJALFE st 367, 66°22' N, 57°16' W, 686 m, 1 spm; between Cape Stevenson and C. Leslie, Scoresbysund, 143 m, 1 sh (all ZMC); the material from the NORWEGIAN NORTH ATLANTIC Exp listed by Friele & Grieg (1901:77) (ZMB).

--North and west of the British Isles, and the Rockall Trough: CHALLENGER 2 st 2, 55°04' N, 12°33' W, 2857 m, 23 spms+shs; st 4, 56°52' N, 10°01' W, 1993 m, 4 spms; st 8, 54°45' N, 12°10' W, 2900 m, 4 spms; st 10, 56°37' N, 11°04' W, 2540 m, 4 spms; st 11, 56°47' N, 10°08' W, 1964 m, 3 shs; st 12, 56°49' N, 10°15' W, 2076 m, 1 spm; st 28, 54°33' N, 12°21' W, 2880 m, 2 spms; --st 64, 56°38' N, 09°29' W, 1400 m, 1 sh; st 137, 54°34' N, 12°19' W, 2900 m, 3 spms (all RSM); INCAL st CP1, 57°57' N, 10°55' W, 2040-2068 m, 2 spms; st CP7, 55°04' N, 12°46' W, 2895 m, 1 spm; st DS1, 57°59' N, 10°40' W, 2091 m, 4 spms; st DS2, 57°59' N, 10°49' W, 2081 m, 2 spms; st DS6, 56°26' N, 11°11' W, 2494 m, 1 spm; st DS7, 55°01' N, 12°31' W, 2884 m, 1 spm (all MNHN); DISCOVERY st 9754#3, 51°08' N, 12°01' W, 1484 m, 11 spms, 2 shs; st 10112#1, 50°26' N, 13°18' W, 2640-2660 m, 2 spms; st 10112#2, 50°25' N, 13°20' W, 2640-2650 m, 3 spms (all BMNH); No locality, figured in British Conchology, 3 spms (height 16 mm!) (USNM 62170); Unst, Shetland, 255 m, 1 spm (USNM 62169); --Shetland, 2 spms (USNM 62171); PORCUPINE 1869 st 23a, 56°13' N, 14°18' W, 773 m, 3 shs (USNM 187595, BMNH 85.11.5.2522); st 42, 49°12' N, 12°52' W, 1577 m, 2 spms (BMNH 85.11.5.2519-20); st 47a, 59°34' N, 07°18' W, 990 m, 2 shs (USNM 187599); st 61, 62°01' N, 05°19' W, 210 m, 1 sh (USNM 187598); st 78, N of Scotland, 528 m, 2 shs (USNM 187597); st 85, N of Scotland, 346 m, 1 sh (USNM 187596); TRITON st 10, 59°40' N, 07°21' W, 945 m, 2 spms (BMNH 85.11.5.4516-7).

--Northwestern Atlantic: FISH HAWK st 892, 39°46' N, 71°05' W, 890 m, 2 shs (USNM 45440); st 895, 39°56' N, 71°00' W, 435 m, 1 spm (USNM 45442); USFC st 947, 39°53' N, 71°13' W, 583 m, 1 spm (USNM 45443); st 994, 39°40' N, 71°30' W, 673 m, 1 spm (USNM 87298); st 997, 39°42' N, 71°32' W, 613 m, 5 spms (USNM 45445, 87299); st 999, 39°45' N, 71°30' W, 487 m, 1 spm (USNM 45446); --st 1093, 39°56' N, 69°42' W, 638 m, 1 sh (USNM 45447); st 1142, 39°32' N, 72°00' W, 589 m, 1 sh (USNM 45448); st 1144, 39°31' N, 72°06' W, 705 m, 1 spm (USNM 45449); ALBATROSS st 2115, 35°49' N, 74°35' W, 1542 m, 6 spms (USNM 35582); st 2171, 37°59' N, 73°49' W, 812 m, 1 sh (USNM 45450); st 2203 or 2212, 39°34' N, 71°41' W, 1290 m, or 39°59' N, 70°31' W, 783 m, 2 spms (USNM 45452); st 2213, 39°58' N, 70°30' W, 702 m, 4 spms (USNM 45453); --st 2221, 39°05' N, 70°44' W, 2790 m, 17 spms (USNM 45454); st 2234, 39°09' N, 72°03' W, 1482 m, 1 spm (USNM 40233); st 2547, 39°54' N, 70°20' W, 713 m, 4 spms (USNM 51162); st 2706, 41°28' N, 65°35' W, 2175 m, 1 spm (USNM 78164); st 2739, 37°34' N, 73°58' W, 1484 m, 1 spm (USNM 78816); off Cape Hatteras, 546 m, 1 spm (USNM 94299).

--Bay of Biscay: THALASSA st X347, 44°07' N, 04°44' W, 640-910 m, 1 spm; st X353, 44°07' N, 04°45' W, 635-655 m, 1 sh; st Z435, 48°40' N, 09°53' W, 1050 m, 1 sh; st Z449, 48°41' N, 10°34' W, 730 m, 1 sh; SARSIA st 7617, 43°42' N, 03°40' W, 900-1100 m, 1 sh; PORCUPINE 1870 st 1, 48°38' N, 10°15' W, 1040 m, 18 spms (USNM 187600); BIOGAS st CP01, 47°35' N, 08°39' W, 2245 m, 1 spm; st DS32, 47°32' N, 08°05' W, 2138 m, 1 spm; st DS71, 47°34' N, 08°34' W, 2194 m, 2 shs; st KG172, 47°32' N, 09°06' W, 2820 m, 1 sh; LAGARDERE st GCh78, 44°30' N, 02°16' W, 1180-1240 m, 1 sh; TRAVAILLEUR 1880 dr "6.20.9" (??), 3 shs (all MNHN).

--Southern Europe and northwestern Africa, continental slope: PORCUPINE 1870 st 16, 39°55' N, 09°56' W, 1809 m, 1 sh (BMNH 85.11.5.2526); st 24, 37°19' N, 09°13' W, 535 m, 17 shs + fragm.; st 30, 36°15' N, 06°52' W, 710 m (BMNH, USNM); BALGIM st DR22, 36°35' N, 07°24' W, 462-472 m, 2 shs; st CP95, 34°24' N, 07°39' W, 1378 m, 2 shs; CANCAP st 4.062, 28°48' N, 13°43' W, 590 m, 2 shs; st 4.064, 28°47' N, 13°41' W, 1030 m, 3 shs; st 4.077, 28°47' N, 13°37' W, 1085 m, 2 shs (RMNH); SEAMOUNT 1 st DW08, 36°29' N, 11°37' W, 470-485 m, 4 shs; st DW16, 36°33' N, 11°33' W, 255-265 m, 1 sh; st CP20, 36°34' N, 11°30' W, 305-320 m, 4 shs; st DW21, 36°35' N, 11°28' W, 460-480 m, 2 shs; st CP30, 36°44' N, 11°23' W, 1940-2075 m, 3 shs; st DW38, 36°42' N, 14°17' W, 235-245 m, 1 sh; st DW43, 36°45' N, 14°17' W, 260-285 m, 2 shs; st DW45, 36°46' N, 14°18' W, 315-335 m, 4 shs; st



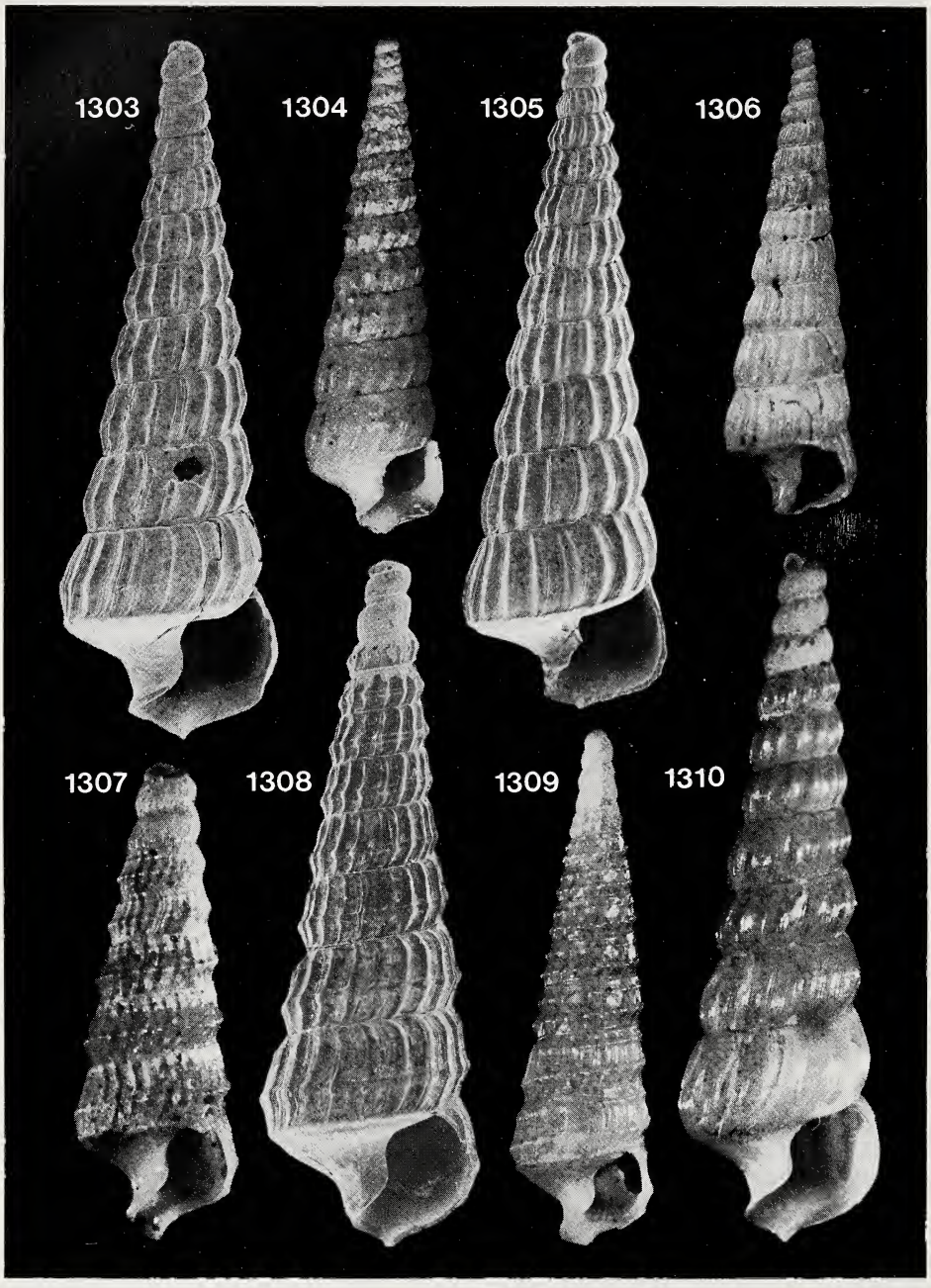
Figures 1299-1302. *Cerithiella metula*. **1299**, DISCOVERY st 9754 3, 7.6 mm. **1300**, Skjalfandi, Iceland, 7.8 mm. **1301**, INGOLF st 10, form *danielsseni*, 7.4 mm. **1302**, ALBATROSS st 2221, off New England, form *whiteavesi*, 10.0 mm (USNM 45454).

DW61, 36°40' N, 14°16' W, 200-205 m, 2 shs; st DE98, 35°03' N, 12°55' W, 300-325 m, 2 shs; st DW108, 42°51' N, 11°53' W, 1110-1125 m, ca. 50 shs and fragments; st DW111, 42°40' N, 11°36' W, 675-685 m, 20 shs; st DW116, 42°52' N, 11°51' W, 985-1000 m, ca 150 shs and fragments.

--Mediterranean: BANNOCK st CS71/4, 36°17' N, 13°42' E, 600 m, 1 sh; BANNOCK 1970, st 14, Adriatic, off Bari, 1 sh (Univ. Bologna); San Procopio, southern Italy, quaternary deposits, 5 fragm. (coll. Crovato); off Siracusa, Sicily, ca.600 m, from local fishing boats, 2 spms (MNHN ex coll. Piani).

Distribution: From the Barents Sea (Herzenstein 1885:682) along the Norwegian coast and Norwegian continental slope into the Skagerrak, normally at depths of 100-500 m (locally more shallow), but extending down to ca 2000 m. In Scandinavia, *C. metula* occurs on bottoms of shell gravel, shell-sand, and silty ooze mixed up with some coarser material, at depths of 50-300 m. It is common in the fjords, on the banks off the coast, and the continental shelf but rare in deeper water.

Further to the south it occurs more sparsely, along the continental slope west of the British Isles and the Bay of Biscay, here deeper, 500-2500 m (more shallow and common on the banks off SW Portugal); and south to the Canaries. It is extremely rare in 200-600 m in the Mediterranean (Taviani 1974, 1978:300; Cecalupo 1985) and some of the records refer to shells which appear to be würmian fossils.



Figures 1303-1310. *Cerithiella metula*: transition to the *danielsseni* and *whiteavesi* forms. **1303**, VÖRINGEN st 192, 7.2 mm. **1304**, VÖRINGEN st 51, lectotype of *C. danielsseni*, 9.4 mm (ZMB 21693). **1305**, VÖRINGEN st 192, 8.9 mm. **1306**, VALOROUS st 12, syntype of *C. procerum*, 9.5mm (USNM 187632). **1307**, ALBATROSS st 891, 790 m, syntype of *C. whiteavesi*, 5.4 mm (USNM 45439). **1308**, CHALLENGER 2 st 2, 2857 m, 8.6 mm. **1309**, holotype of *C. gracile*, 7.6 mm (BMNH 1885.11.5.2524). **1310**, INGOLF st 117, 8.6 mm.

Cerithiella metula is rather common south, west, and northwest of Iceland from ca 150 m and deeper (Thorson 1941, Oskarsson 1982), and probably has a continuous distribution along the Reykjanes Ridge and the Mid-Atlantic Ridge to the Azores, where it is known from a single record in 1600 m. It is known from southeastern Greenland along the northeastern United States, as far south as Cape Hatteras, in 500-2500 m.

Remarks

Nomenclature: Monterosato (1884) introduced, without description ("the specimen in the Hanley collection, on which is based Jeffreys' record, differs by the shape, proportions, sculpture, apex etc.."), or figure, the name *Cerithiella hanleyana* for a Mediterranean specimen of *C. metula* cited by Jeffreys (1867:257), from "Villa Franca (Hanley)" without further detail. *C. hanleyana*, despite being a *nomen nudum*, has been listed in Mediterranean checklists (Bruschi et al. 1985:15; Sabelli et al. 1990:179).

The shell could not be found (A. Norris, in litt.) in Leeds City Museum, where the Hanley collection is kept.

Variation: Cerithiella metula exhibits considerable variation, as the long list of synonyms indicates. It has non planktotrophic larval development and hatches as a crawling juvenile (Figs 1317-1318). As a consequence groups of populations tend to exhibit local characters due to lack of genetic exchange.

Individual variation. Cerithiella macrocephala was based on specimens with an inflated and bulbous protoconch (Fig. 1297). Scattered such specimens have been observed in populations of otherwise typical *C. metula*, from Norway and the Galicia Bank (Figs 1312-1313). Therefore we interpret that appearance of the protoconch as individual variation.

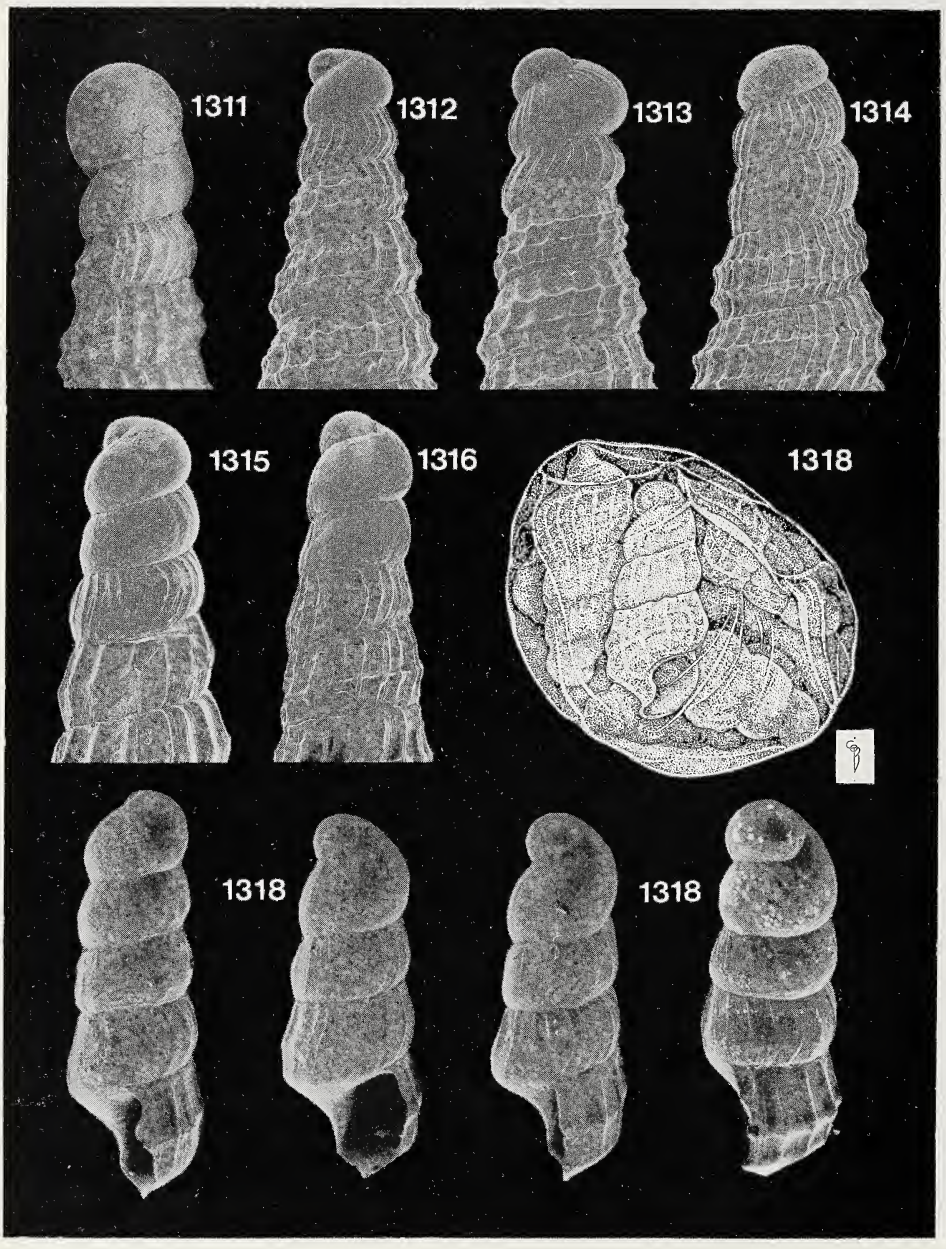
In shallow water gastropods with development involving adelphophagy, the number of eggs and of nurse eggs per capsule is known to vary (Spight 1976a and b; Rivest 1983). In the buccinid *Searlesia dira* different egg capsules may have as few as 7 or as many as 172 nurse eggs per developing embryo. Following this, a developing embryo feeding on an unusually large quantity of nurse eggs hatches with a large bulbous protoconch, and a variation in hatching size from 0.8 to 2.4 mm has been reported (Rivest 1983). We interpret the variability in protoconch size and shape in *C. metula* as a consequence of this phenomenon.

Geographical variation. Cerithiella metula, as described by Lovén (Fig. 1295), is usually sculptured with 3 spiral cords, which form tubercules where they cross the sharp axial ribs. The adapical cord is generally the weaker of these. A very thin transparent periostracum covers the glassy white shell. This is the normal appearance of specimens from the Norwegian and Icelandic continental shelf.

This form is connected via intermediate specimens to several other locally recognisable geographic forms:

(1) In deep water (1000-1500 m) in the Norwegian Sea, it clines into a form which lacks the adapical cord and has a thick brown greenish periostracum (Fig. 1301). This form has only two broad spiral cords and the axial ribs become very broad. The intersections of the axial- and spiral sculpture form indistinct nodules, more pronounced on the upper whorls. This is the form which has been described as *C. danielsseni* (Fig. 1301). Another form was described as *procerum*, and has only axial ribs (Fig. 1306). Such variants occur in the same populations as typical *danielsseni*, in the deep bathyal parts of the Norwegian sea, and also south of the Wyville Thomson Ridge in the northern part of the Rockall Trough in 2000-2500 m.

(2) In northwestern Iceland occur scattered specimens similar to *danielsseni*, but with more numerous axial ribs (Figs 1300-1301). Such specimens are indistinguishable from the types of *C. whiteavesii*, described from off New England, where this is the dominant appearence. Here, in the northwestern Atlantic, the variation is more limited, from typical *whiteavesii* with numerous, axial riblets and one strong spiral keel (Fig. 1307), in shallow water, down to 500-1000 m. Specimens from deeper water have fewer axial ribs and two spiral cords (Fig. 1302). *Cerithiella martensi* (Dall,



Figures 1311-1318. *Cerithiella*: egg capsule, embryos and protoconchs. **1311**, *C. metula*, holotype of C. macrocephala. **1312-1313**, *C. metula*, off Bergen, 60°07' N, 04°54' E, 240-250 m, variant showing a tendency to the *macrocephala* type of apex. **1314**, *C. metula*, BIOGAS st CP1. **1315**, *C. metula, danielsseni* form, VÖRINGEN st 192. **1316**, *C. amblytera*, MONACO Exp st 213. **1317**, *C. metula*, egg capsule, INCAL st DS9. **1318**, embryos dissected out from the egg capsule in fig. 1317.

1889), from off the Florida Keys, 420 m, is superficially similar and may belong to this cline, but no specimen of *Cerithiella* similar to *whiteavesii* has been collected between Cape Hatteras and southern Florida, and we prefer to leave this problem unsolved.

(3) In the Bay of Biscay and southwards occur specimens with sculpture similar to Norwegian *metula*, with transparent periostracum, and white shell with three spiral rows of granules. They are rare and the depth range is 500-1500 m. Similar specimens have been found in the Mediterranean (Fig. 1296). In deeper water (ca 1000-2000 m), the upper row of granules becomes obsolete and only two spiral cords remain (Fig. 1298). *Cerithium bizonalis* was probably based on such specimens. We are not certain that this form is specifically distinct from *C. amblytera*. In the southern part of the range (Azores, Portugal, Morocco), there are no problems to distinguish *metula* and amblytera, but certain Icelandic specimens of the *danielsseni* form are confusingly similar to *C. amblytera*.

Cerithiella amblytera (Watson, 1880) Figs 1316, 1319-1324

Cerithium (Bittium) amblyterum Watson, 1880:108; 1886:542, pl. 39 fig. 6.
Cerithium (Bittium) mamillanum Watson, 1880:109; 1886:543, pl. 40 fig. 6.
Cerithiopsis amblytera var. *attenuata* Locard, 1897:382.

Type materials: C. amblyterum, holotype BMNH 1887.2.9.1696; *C. mamillanum*, holotype BMNH 1887.2.9.1697; *C. a.* var. *attenuata*, holotype in MNHN.

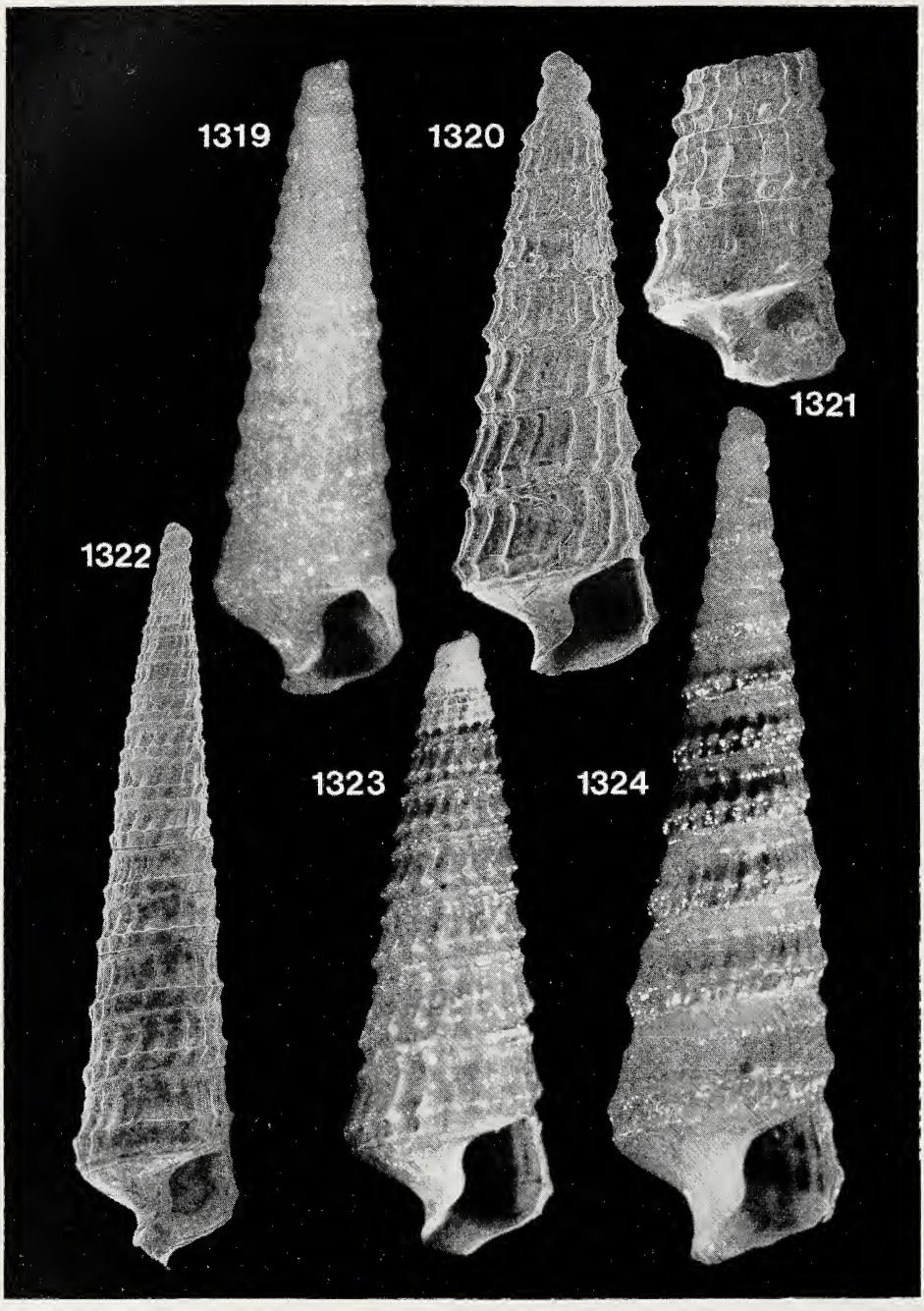
Type localities: C. amblyterum, CHALLENGER st 75, 38°38' N, 28°29' W, 823 m (Azores); *C. mamillanum*, CHALLENGER st 120, 08°37' S, 34°28' W, 1235 m (off NE Brazil); *C. amblytera* var. *attenuata*: TRAVAILLEUR 1882 dr 40, 33°09' N, 09°30' W, 1900 m (off Morocco).

Material examined: The type material and --
--Azores: MONACO Exp st 112, 38°34' N, 28°06' W, 1287 m, 1 spm; st 211, 39°18' N, 31°12' W, 1372 m, 1 sh; st 213, 39°23' N, 31°25' W, 1384 m, 1 spm; st 233, 38°33' N, 28°09' W, 1300 m, 9 shs; st 244, 38°34' N, 28°19' W, 1266 m, 1 spm, 1 sh; st 553, 37°43' N, 25°05' W, 1385 m, 3 spms, 3 shs; st 575, 38°27' N, 26°30' W, 1165 m, 1 spm, 1 sh; st 578, 38°26' N, 26°31' W, 1165 m, 2 shs; st 683, 38°20' N, 28°05' W, 1550 m, 1 sh; st 703, 39°21' N, 31°06' W, 1360 m, 1 spm, 4 shs; st 719, 39°11' N, 29°06' W, 1600 m, 3 fragms; st 738, 37°40' N, 26°26' E, 1919 m, 3 shs; st 1311, 37°37' N, 25°21' W, 1187 m, 1 sh; st 1349, 38°35' N, 28°06' W, 1250 m, 1 sh; st 3293, 38°47' N, 30°16' W, 1331 m, 1 sh (IRSN, MOM, MNHN); BIACORES st 64, 38°43' N, 28°29' W, 1200-1240 m, 1 spm (MNHN).
--Madeira, Cape Verde Basin: DISCOVERY st 8528, 17°41' N, 18°40' W, 3150 m, 5 shs; --st 9132#7, 20°59' N, 18°59' W, 3090 m, 2 spms; st 9541#3, 20°08' N, 21°41' W, 3910 m, 1 sh; st 10141, 24°34' N, 19°41' W, 3460-3470 m, 3 spms (BMNH, MNHN).
--Tropical Atlantic: VALDIVIA st 56, 03°10' N, 05°28' E, 2278 m, Gulf of Guinea, 1 sh (ZMHU); MARION-DUFRESNE cruise 55, st CB95, 19°38' S, 38°43' W, 960 m, SE Brazil, 23 spms and shs (MNHN).

Distribution: The Atlantic between 20° S and 40° N in, 1000-4000 m depth.

Remarks: Specimens from off Brazil, the Gulf of Guinea (Fig. 1323) and the Azores (Fig. 1319) are remarkably similar despite the vast distances (ca 5000 km) that separate them. Such specimens have rather flat whorls with two spiral cords close to the suture. Of these, the abapical one is stronger and they are joined by broad axial ribs. The shell is covered by a thick greenish brown periostracum.

Shells from the Azores are more variable and some specimens have a very weak axial sculpture and concave whorls (Fig. 1322). As noted above under *C. metula*, some specimens from Iceland



Figures 1319-1324. *Cerithiella amblytera*. **1319**, holotype, 5.6 mm (BMNH 1887.2.9.1696). **1320**, DISCOVERY st 10141, 8.7 mm. **1321**, holotype of *C. mamillanum*, 1.9 mm. **1322**, MONACO Exp st 213, 11.4 mm. **1323**, VALDIVIA st 56, 6.3 mm. **1324**, BIACORES st 64, 8.3 mm.

are intermediate, which could indicate that there is a clinal variation between *metula* and *amblytera*. In a similar way the deep form of *whiteavesii* from the northwestern Atlantic resembles *amblytera*, which also supports conspecificity.

Cerithiella enode (Watson, 1880) Figs 1325-1327

Cerithium (Bittium) enode Watson, 1880:115; 1886:541, pl. 39 fig. 3.

Type material: 2 syntypes BMNH 1887.2.9.1694-5.

Type locality: CHALLENGER st 120, 08°37' S, 34°28' W, 1235 m (off NE Brazil).

Material examined: The type material and --INCAL st OS4, 46°04' N, 10°12' W, 4796 m, 1 sh (MNHN); DISCOVERY st 8524#6, 20°43' N, 22°44' W, 4432 m, 1 sh; st 9131#10, 20°15' N, 21°35' W, 3950 m, 1 sh; st 9131#12, 20°07' N, 21°36' W, 3860 m, 2 shs; st 10141, 24°34' N, 19°41' W, 3460-3470 m, 1 spm; st 10145, 24°51' N, 28°44' W, 4255 m, 1 sh (BMNH, MNHN); ABYPLAINE st DS7, 34°06' N, 17°04' W, 4270 m, 1 sh (MNHN).

Distribution: The abyssal zone of the Atlantic as far north as the Bay of Biscay. Only known from the material examined.

Remarks: Cerithiella enode can be recognized by its thick yellowish green periostracum, the strong subsutural spiral sculpture, the conspicuous spiral cord running at about 2/3 of the height of the whorls and the thin axial sculpture.

The type locality off Brazil is considerably more shallow than all northeast Atlantic records, but it is our general experience that the abyssal fauna starts much more shallow off Brazil than in the northeastern Atlantic.

The type specimens (Fig. 1325) differ from the northeastern Atlantic specimens (Fig. 1327) in having a more convex base (an immature feature), but are otherwise very similar. It is interesting to note that both the CHALLENGER at st 120 off Brazil and the DISCOVERY at st 10141 off Morocco found *C. enode* and *C. amblytera* sympatrically.

Cerithiella insignis (Jeffreys, 1885) Figs 1273, 1291, 1328-1329

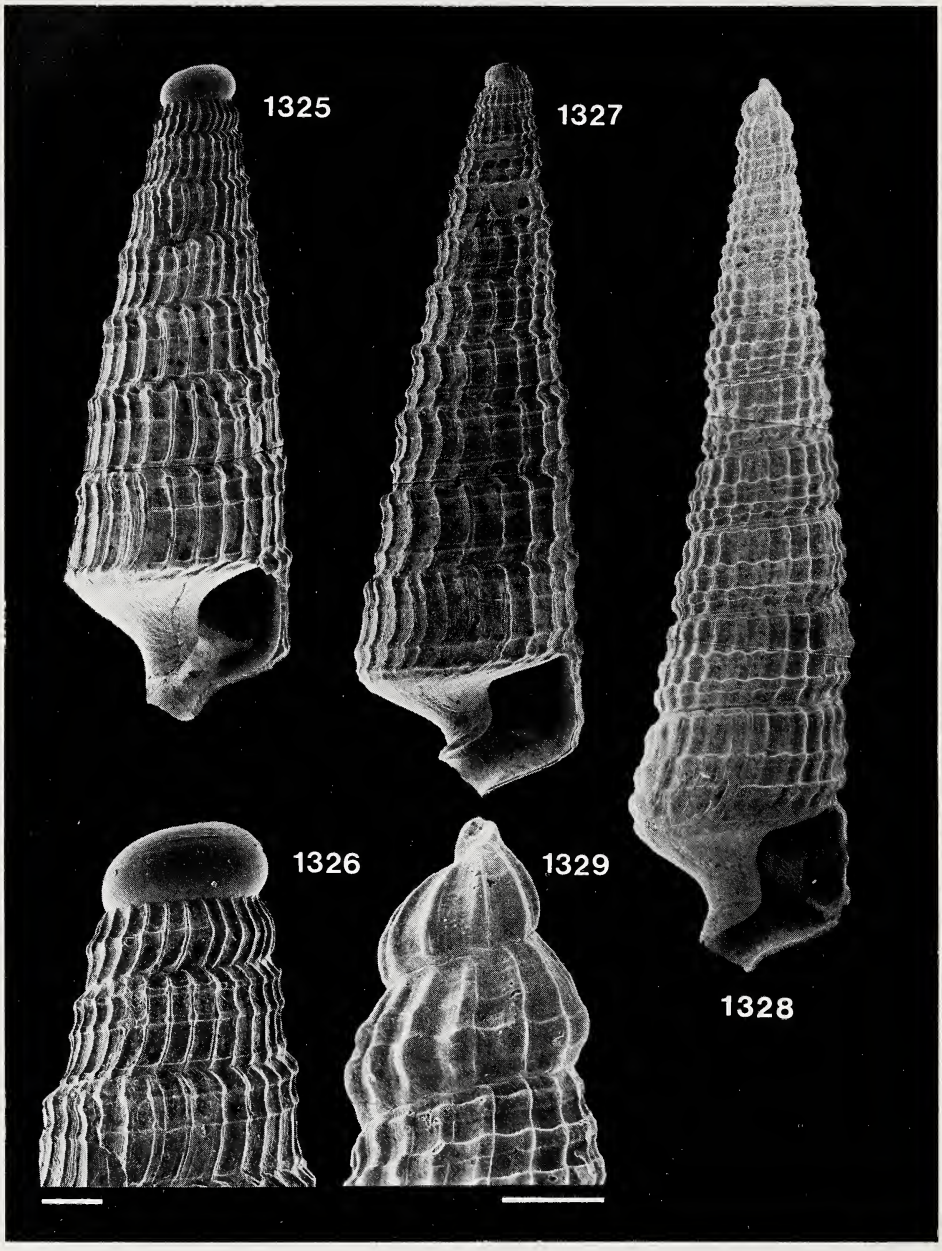
Stilus insignis Jeffreys, 1885:52, pl. 6 figs 1-1a.

Type material: 5 syntypes in BMNH 85.11.5.2622-2624, 2642-2643; 5 syntypes in USNM 177232-177236.

Type locality: PORCUPINE 1870 st 29, 31, 32, 33 and 34, all in the Ibero-Moroccan Gulf, 415-1190 m, were listed in the original description.

Material examined: The type material and --BALGIM st DW74, 33°52' N, 08°13' W, 181 m, 1 spm; st DR81, 33°46' N, 08°30' W, 309 m, 1 sh (MNHN); PORCUPINE 1870 st 29, 36°20' N, 06°47' W, 415 m, 1 fragm. (USNM 177232); st 30, 36°15' N, 06°52' W, 710 m, 1 sh (BMNH); st 31, 35°56' N, 07°06' W, 873 m, 1 sh (USNM 177233); st 32, 35°41' N, 07°08' W, 1190 m, 1 sh (USNM 177234); st 33, 35°33' N, 06°54' W, 1015 m, 2 fragms (USNM 177235); st 34, 35°44' N, 06°53' W, 758 m, 1 sh (USNM 177236); off SW Gorée, Senegal, 150-250 m, 2 shs (MNHN, leg. Marche-Marchad).

Distribution: Only known from the material examined, from the Ibero-Moroccan gulf to Senegal, ca 180-1200 m.



Figures 1325-1329. Genus *Cerithiella*. **1325-1326**, *C. enode*, syntype, 4.8 mm. **1327**, *C. enode*, DISCOVERY st 10141, 7.9 mm. **1328-1329**. *C. insignis*, BALGIM st DW74, 6.8 mm. Scale lines 200 μm.

Genus *EUMETULA* Thiele, 1912

Eumetula Thiele, 1912:305. Type species, by monotypy, *E. dilecta* Thiele, 1912. Antarctic.
Eumeta Mörch, 1870:208 (not *Eumeta* Walker, 1855). Type species, by monotypy, *Cerithium arcticum* Mörch, 1857. North Atlantic.
Laskeya Iredale, 1918:30 (*nom. nov.* for *Eumeta* Mörch, 1870).

Remarks: We have examined the radula of *E. dilecta* (described but not figured by Thiele (1912)) from the Weddell Sea. Its central tooth is narrower and has fewer cusps than *E. arctica* (Fig. 1282), and its marginals have longer, slender bases. These differences however are only a matter of degree, and the general morphology is very similar. A similar radula was found in the Magellanic species *"Cerithium" pullum* Philippi, 1845 (figured by Powell (1951) as *Ataxocerithium pullum* and confirmed by us). We consider the differences compared with *Eumetula arctica* to be of specific value only. Our impression is that all transitions in the number of cusps on the central tooth exist, from few in *Eumetula* to numerous in *Laskeya*. Therefore we synonymize the two genera. The shell of *E. dilecta* has a sculpture of intersecting axial ribs and spiral cords, while almost only axial sculpture is present in *E. arctica*, but intermediate kinds of sculpture exist in other Antarctic and south Australian cerithiopsids (material in AMS, radulae not known).

Laskeya was treated by Thiele (1929) and Gründel (1980) as a subgenus of *Eumetula*.

Other similar and/or related genera are: *Altispecula* Powell, 1930 (type species by original designation, *Cerithiopsis geniculosus* Hedley, 1911, South Australia); *Furukawaia* Kuroda & Habe, 1961 (type species by monotypy, *F. fukuiensis* (Kuroda & Habe, 1954), northern Japan); and *Marshallaskeya* Gründel, 1980 (type species by original designation, *Altispecula elegantula* Powell, 1930, northern New Zealand). The radulae of their type species are not known. Golikov & Gulbin (1978:219, fig. 24-8) figured (also examined by us) the radula of *Furukawaia habei*, from the Kuriles, 150-170 m, with central and lateral teeth which are similar to those of *E. dilecta*, but with fewer cusps. Marshall (1978) has discussed *Altispecula* and *Furukawaia* and considered them subgenera, possibly synonyms, of *Laskeya*. We suspect all these genera to be synonyms of *Eumetula*, but knowledge about the radulae of each type species is needed to substantiate our suspicions.

Eumetula arctica (Mörch, 1857) Figs 1282, 1292, 1330-1333, 1343

Turritella costulata Möller, 1842:83 (not *T. costulata* Borson, 1825, not Mighels & Adams, 1842 (January)).
Cerithium arcticum Mörch, 1857:82, *nom. nov.* for *Turritella costulata* Möller, 1842.
Cerithium naiadis Woodward (in synonymy): Jeffreys 1859:115; 1867:273. (See also the comments by Iredale 1918.)

Type material: 2 syntypes in ZMC.

Type locality: The syntypes in ZMC originate from off Sukkertoppen, southwestern Greenland.

Material examined: The type material and
--Scandinavia to the northern British Isles: 66 spms and shs from northern and western Norway (ZMO, USNM); about 300 shells from Korsfjorden and Raunefjorden, southwestern Norway, and the Koster area, Skagerrak (SMNH); off Unst, Shetland Is, 1 sh (USNM 62178); western coast of Shetland Is, 1 old sh (USNM 62179); PORCUPINE 1869, N of the Hebrides, 1 spm (BMNH 85.11.5.2636); W of Ireland, 1 sh (BMNH 85.11.5.2635); st 4, 51°56' N, 13°29' W, 457-981 m, 1 sh (BMNH 85.11.5.2633); st 23, 56°07' N, 14°19' W, 1147 m, 3 shs (BMNH 85.11.5.3924-26); TRITON st 8, 60°18' N, 06°15' W, 1165 m, 1 spm (BMNH 85.11.5.4518); BIOFAR st 029, 61°50' N,

05°25' W, 170 m, 1 spm; st 341, 62°07' N, 09°45' W, 710 m, 1 spm; st 355, 62°34' N, 05°58' W, 149 m, 1 spm; st 358, 62°00' N, 04°32' W, 300 m, 1 spm.

--Iceland and Greenland: INGOLF st 10, 64°24' N, 28°50' W, 1484 m, 4 shs; st 39, 62°00' N, 22°38' W, 1629 m, 2 shs; st 78, 60°37' N, 27°52' W, 1505 m, 1 sh; st 81, 61°44' N, 27°00' W, 913 m, 1 sh; st 87, 65°02' N, 23°56' W, 207 m, 1 sh; st 90, 64°45' N, 29°06' W, 1070 m, 2 shs (all ZMC); THOR 1903, st 5, 61°35' N, 04°39' W, 400 m, 1 sh; st 27, 64°58' N, 13°25' W, 76 m, 1 sh; 63°30' N, 20°14' W, 80 m, 1 sh; 61°40' N, 07°40' W, 200 m, 4 shs; Patreksfjord, western Iceland, 250 m, a few shs; SSE of Reykjanes, Iceland, 216-232 m, 2 spms (ZMC); 60°05' N, 47°11' W, 880-1195 m, 4 shs; 60°05' N, 46°44' W, 1010-1195 m, 1 sh (both in National Museum of Canada; Clarke 1974:6, as *Epitonium obtusicostatum* in part); western to southwestern Iceland, from Vestfjord to Reykjanes Ridge, 100-360 m, many spms (coll. Hans Larsen); off southeastern Greenland, 65°17' N, 36°28' W, 199 m, 1 sh, (coll. Jón Bogason).

Distribution: From the White Sea (Scarlato 1987), along northern Norway, southwards along the coast of Norway into the Skagerrak (Sars 1878, Friele & Grieg 1901, and material in ZMO, SMNH), the Faroes (Spärck & Thorson 1933), to north of the British Isles. *Eumetula arctica* is common all around Iceland (Thorson 1941, Oskarsson 1982, and material in ZMC, SMNH), western and eastern Greenland (Thorson 1944), along the North American shelf as far south as New England (Verrill 1882). A single record from "west of Ireland" (Jeffreys 1885, material in BMNH) is questionable.

Records from the Bay of Biscay (Locard 1897, repeated by Hidalgo 1917) are erroneous (material examined in MNHN, see *Eumetula bouvieri* below).

Bathymetrical distribution, 100-500 m with occasional shallower (to 35 m in the White Sea) and deeper records (1600 m).

Remarks: We have examined the 3 syntypes (USNM 62195) of *Cerithiopsis nivea* Jeffreys, 1859. All three are fragmentary, they are shiny and polished and appear to be fossil. They have a general resemblance to *E. arctica*, but the columellar region is much thickened, and we consider them specifically distinct from *arctica*. Possibly they are washed out fossil shells.

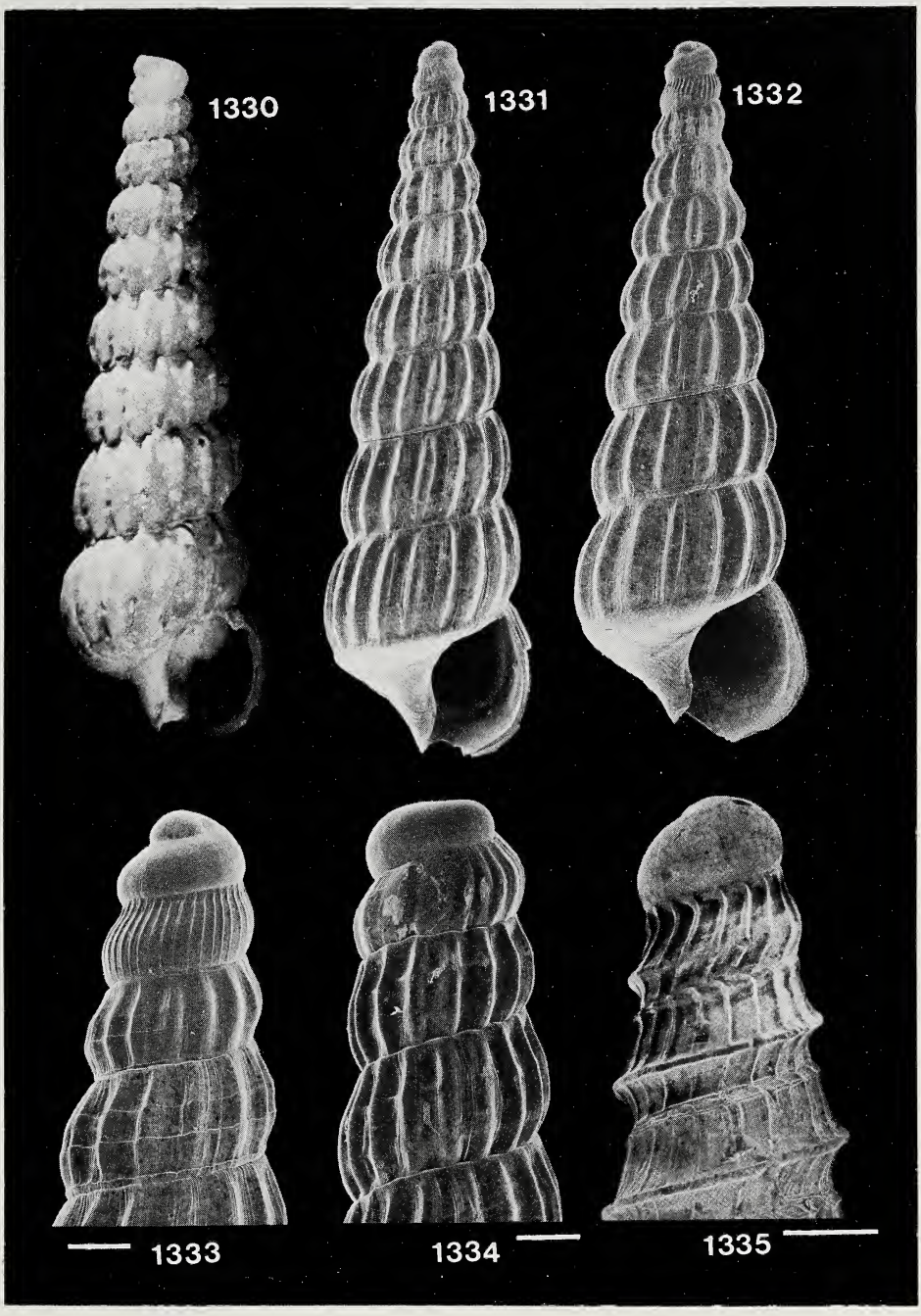
Eumetula bouvieri (Dautzenberg & Fischer, 1896) Figs 1334, 1336-1340

Cerithiella bouvieri Dautzenberg & H. Fischer, 1896:446, pl. 18 fig. 4; Dautzenberg 1927:110, pl. 1 fig. 27.

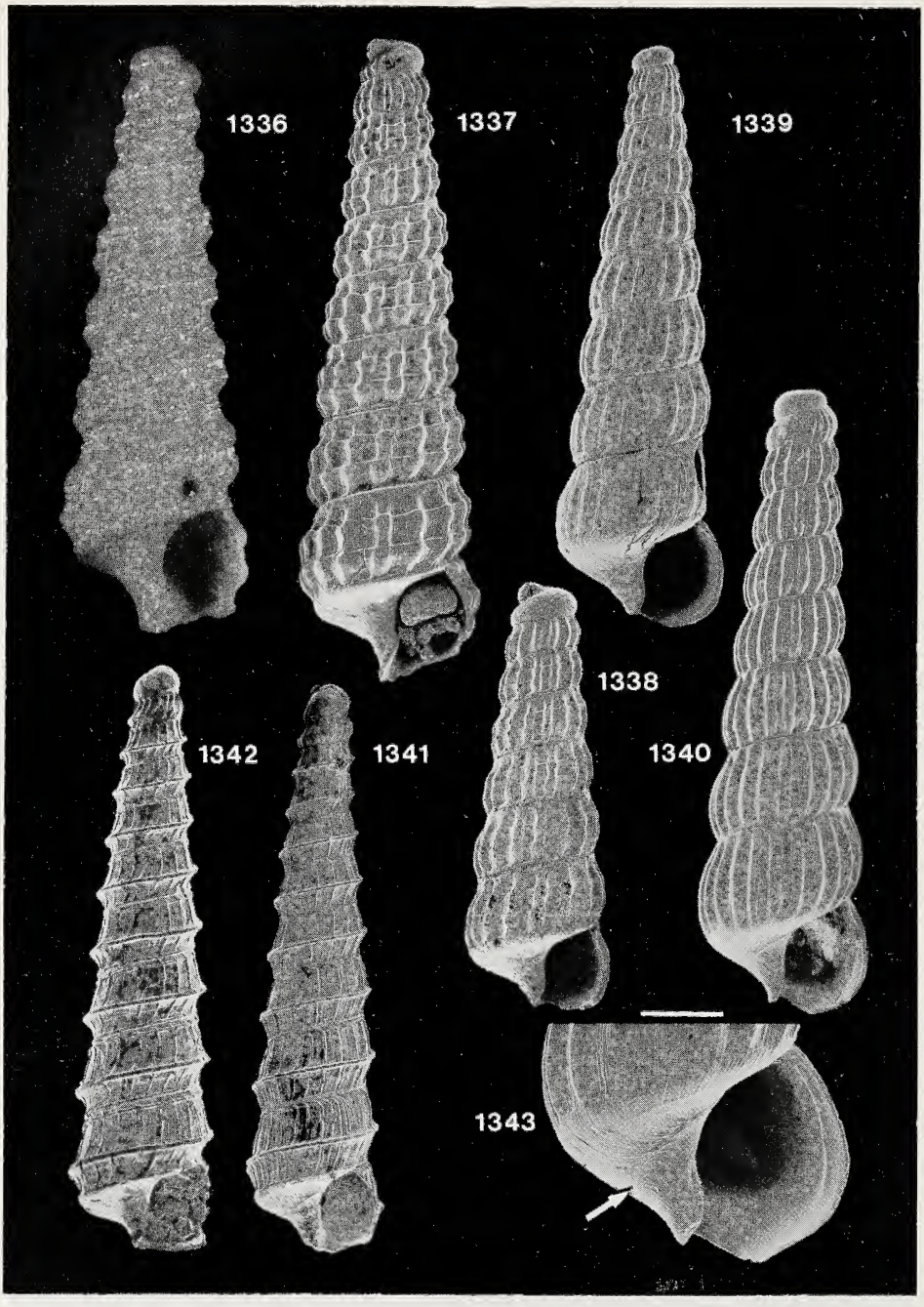
Type material: Lectotype, here designated, the shell figured by Dautzenberg and Fischer, in MOM.

Type locality: MONACO Exp st 234, 39°02' N, 27°55' W, 454 m (Azores).

Material examined: The type material and --MONACO Exp st 553, 37°43' N, 25°05' W, 1385 m, 1 sh; --st 2214, 39°26' N, 31°21' W, 650-914 m, 2 shs; TRAVAILLEUR 1881, dr 1, 43°01' N, 09°38' W, 2018 m, 1 sh; dr 40, 44°05' N, 07°05' W, 392 m, 1 sh (Locard 1897:382 as *Cerithiopsis costulata*); TRAVAILLEUR, no data, 1 fragm. (USNM 187606, coll. Jeffreys ex de Folin); CANCAP st 4.077, 28°47' N, 13°37' W, 1085 m, 1 sh; SEAMOUNT 1 st DW08, 36°29' N, 11°37' W, 470-485 m, 2 shs; --st DE10, 36°27' N, 11°35' W, 500-545 m, 1 spm, 1 sh; st CP20, 36°34' N, 11°30' W, 305-320 m, 1 sh; st DW108, 42°51' N, 11°53' W, 1110-1125 m, 2 shs; st DW111, 42°40' N, 11°36' W, 675-685 m, 11 shs + fragms; st DW116, 42°52' N, 11°51' W, 985-1000 m, 15 shs + fragms.



Figures 1330-1335. Genus *Eumetula*. **1330**, *E. arctica*, lectotype, Sukkertoppen, 9.3 mm. **1331-1333**, *E. arctica*, Bergen area, North of Marsteinen, 300-330 m, 6.5 mm and 6.4 mm. **1334**, *E. bouvieri*, CANCAP st 4.077. **1335**, *E. aliceae*, Quaternary of San Procopio.
Scale lines 200 μm.



Figures 1336-1343. Genus *Eumetula*. **1336**, *E. bouvieri*, MONACO Exp st 553, 5.9 mm. **1337**, *E. bouvieri*, SEAMOUNT st DW8, 5.7 mm. **1338**, *E. bouvieri*, SEAMOUNT st DW116, 3.7 mm. **1339**, *E. bouvieri*, TRAVAILLEUR 1881 dr 40, 6.0 mm. **1340**, *E. bouvieri*, CANCAP st 4.097, 5.5 mm. **1341**, *E. aliceae*, holotype, 4.8 mm. **1342**, *E. aliceae*, Quaternary of San Procopio, 4.0 mm. **1343**, *E. arctica*, Bergen area, North of Marsteinen, 300-330 m, scale line 0.5 mm; the arrow indicates the position of the basal cord.

Distribution: From the southern part of Bay of Biscay to northwestern Africa, the banks off the Iberian peninsula and the Azores, bathyal. Only known from the material examined.

Remarks: The shells vary considerably in the strength of the spiral sculpture. This variation appears to be geographical. Weakly sculptured shells (Fig. 1338-9) occur in the northern part of the range (the Bay of Biscay and the Galicia Bank), while coarsely sculptured shells (Fig. 1336) are known only from the Azores. Shells from the Gorringe bank (Fig. 1337), which is somewhat geographically intermediate, are also intermediate in the strength of the sculpture. Weakly sculptured shells from the northern part of the distribution resemble *E. arctica*, but the spiral sculpture consists of sharp incised lines in *arctica* and broad, poorly demarcated cords in *bouvieri*. The protoconch is very blunt in *Eumetula bouvieri*, while it is always conical in *E. arctica* all over its range.

The absence of a siphonal notch in *Cerithiella bouvieri* and the basal cord indicate an inclusion in *Eumetula* rather than in *Cerithiella*. This needs to be confirmed by examination of the radula when soft parts become available.

Eumetula aliceae (Dautzenberg & Fischer, 1896) Figs 1335, 1341-1342

Cerithiella alicei Dautzenberg & H. Fischer, 1896:446, pl. 18 fig. 12; Dautzenberg 1927:110, pl. 1 fig. 26.

Type material: Holotype in MOM.

Type locality: MONACO Exp st 578, 38°26' N, 26°31' W, 1165 m (Azores).

Material examined: The holotype and --San Procopio, southern Italy, quaternary deposits, 7 shs + fragm (coll. Crovato).

Distribution: Only known from the material examined, from the Azores in 1165 m. Quaternary fossil in Italy.

Remarks: Since the specific name is formed from "Princesse-Alice" (feminine), it must be emended to *aliceae*.

Dautzenberg (1927) listed *C. aliceae* from one additional station in the Azores but this material was not found in MOM. The presence in fossil deposits in southern Italy (Rindone & Vazzana 1989) indicates a wider distribution.

As for *C. bouvieri*, the absence of a drawn out siphonal canal indicate that *Eumetula* is a conchologically more appropriate genus than *Cerithiella*. The spiral keel is remarkable and makes identification easier.

Genus *KRACHIA* Baluk, 1975

Cerithiopsis (Krachia) Baluk, 1975:163. Type species, by original designation, *Cerithiopsis korytnicensis* Baluk, 1975. Miocene, Poland.

Remarks: We use the genus *Krachia* for three European deep-water species which all have two smooth cords encircling the base of the shell. Of these species, the radula is known only for *K. cossmanni* (Fig. 1280), but a similar radula is found in the European shallow-water species *"Cerithiopsis" tiara* Watson, 1886 and *"C." cylindrata* (Jeffreys, 1885) (unpublished). These two species also

have two smooth cords encircling the base of the body-whorl, and therefore we consider this a synapomorphy. This character is also present in *Krachia* and *Mendax*, which conchologically resemble the Recent European species discussed above. Marshall (1978:63) described and illustrated the radula of *M. trizonalis* (Odhner, 1924), type species of *Mendax*. Its central tooth has a broad square base with long hair-like cusps grouped near the margin of the cutting edge. In *K. cossmanni*, the central tooth is broad and short, with shorter and stronger cusps all along the cutting edge. Both *Cerithiopsis cossmanni* and *Mendax trizonalis* have long, slender brush-like lateral and marginal teeth, but we consider the differences in the central teeth important enough to maintain two separate, although related genera.

Based on the close conchological resemblance of *Cerithiopsis tiara* and *C. cossmanni* with the Miocene type species of *Krachia*, we conclude that they are congeneric. Regrettably, this cannot be proved or disproved by radular characters, but we find a placement of the Recent species in *Krachia* a better alternative than erecting a new genus for them. From shell characters, Marshall (1978) considered *Alipta* to be closely related to *Mendax*. We have examined the radula of *Alipta crenistria* (Suter, 1907), type of *Alipta*, and it is not similar to that of *Mendax* (Bouchet & Warén in prep.).

Krachia cossmanni (Dautzenberg & Fischer, 1896)
Figs 1280, 1289, 1344-1345, 1356

Cerithiella cossmanni Dautzenberg & H. Fischer, 1896:445, pl. 18 fig. 9; Dautzenberg 1927:111, pl. 1 fig. 28.

Type material: Lectotype, here selected, the shell figured by Dautzenberg & Fischer, and 2 paralectotypes in MOM.

Type locality: Lectotype from MONACO Exp st 553, 37°43' N, 25°05' W, 1385 m (Azores).

Material examined: The type material, and --MONACO Exp st 233, 38°33' N, 28°09' W, 1300 m, 3 spms, 1 sh; st 683, 38°20' N, 28°05' W, 1550 m, 1 sh; off Korsfjorden, W and NW of Marsteinen, ca. 60°08' N, 04°50 to 05°00' E, 240-420 m, 200 spms and shs; INGOLF st 78, 60°37' N, 27°52' W, 1505 m, 1 sh; st 90, 64°45' N, 29°06' W, 1070 m, 1 spm, 4 shs; BIOFAR st 158, 61°38' N, 05°38' W, 322 m, 1 spm; st 355, 62°34' N, 05°58' W, 149 m, 1 sh.

Distribution: Only known from the material examined, from the Azores, southwestern Iceland (Warén 1991), southwestern Norway, and the Faroes, 150-1300 m.

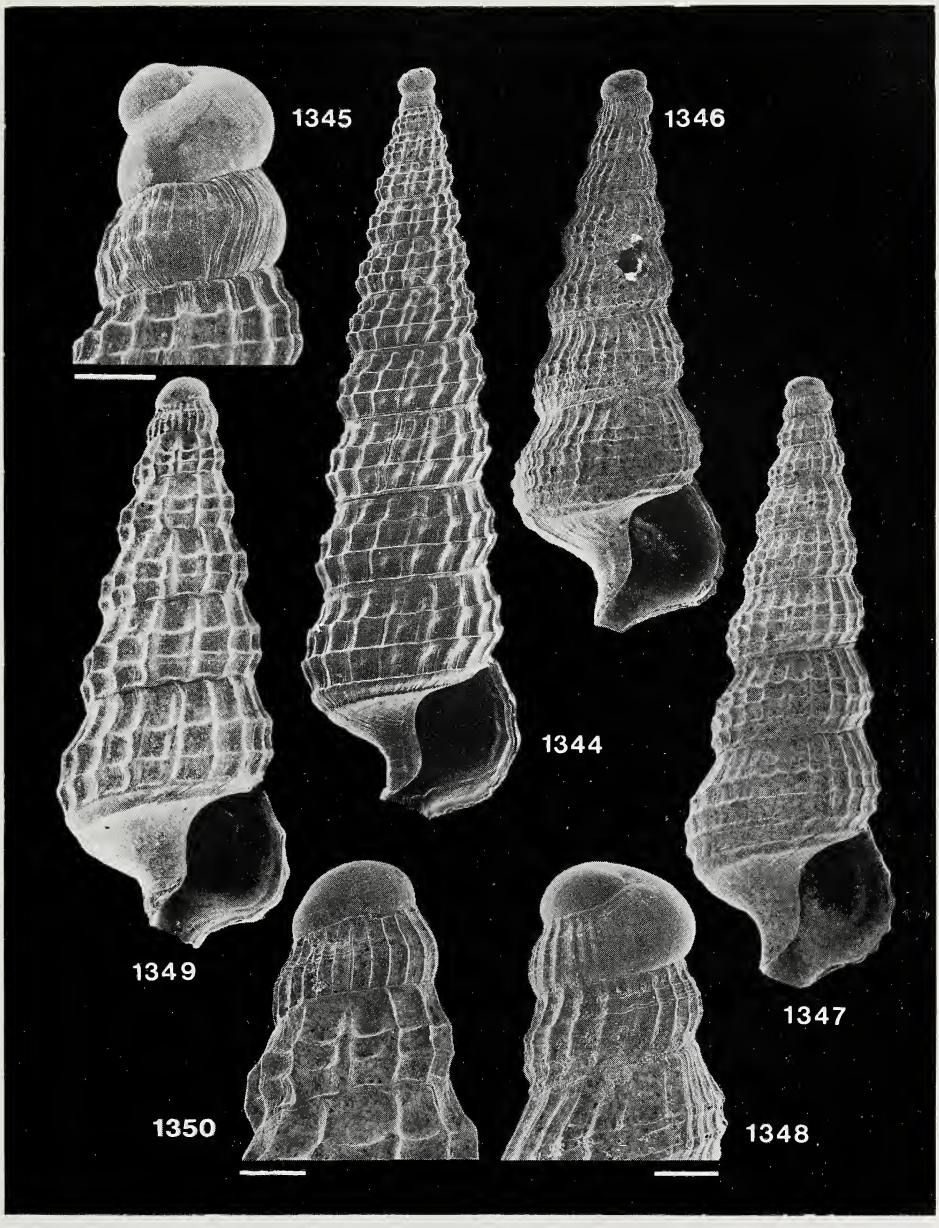
Remarks: Dautzenberg (1927) listed additional specimens from st 234 (39°02' N, 27°55' W, 454 m), and st 719 (39°11' N, 29°06' W, 1600 m) but these specimens were not found (st 234) or had been destroyed by an acidic glass tube (st 719).

Locard (1897) recorded the species from the shore of Desertas Is (near Madeira) but we have not found this sample and believe the record to be erroneous.

Norwegian (Fig. 1344) and Azorian specimens (Fig. 1356) of *K. cossmanni* differ only in the latter usually having one more protoconch whorl (2.5 and 1.5 respectively), but are otherwise very similar.

Krachia guernei has a less granular sculpture than *K. cossmanni*, and is smaller.

K. producta (Dall, 1927) (new combination), from off the southeastern United States, appears to be a similar, larger species. The holotype, 8.5 mm high, has 9 teleoconch whorls, whereas a shell of *K. cossmanni* with 9 teleoconch whorls is 6.5 mm high. The protoconch of *K. cossmanni* (diameter 400-480 μm) is smooth, occasionally with a few axial riblets before the protoconch - teleoconch demarcation. The protoconch of *K. producta* has a sculpture of strong broad axial ribs and fine spiral threads, and its diameter is 560 μm. The teleoconch sculpture of *K. producta* also has a more distinct adapical spiral cord.



Figures 1344-1350. Genus *Krachia*. **1344**, *K. cossmanni*, Bergen area, NW of Marsteinen, 300-400 m, 7.8 mm. **1345**, *K. cossmanni*, Bergen area, NW of Marsteinen, 300-400 m. **1346**, *K. obeliscoides*, syntype, PORCUPINE st 17, 5.9 mm. **1347**, *K. obeliscoides*, MONACO, no loc., Azores, 5.7 mm. **1348**, *K. obeliscoides*, syntype. **1349-1350**, *K. guernei*, MONACO st 233, 3.9 mm. Scale lines 200 μm.

Krachia obeliscoides (Jeffreys, 1885) Figs 1346-1348

Cerithium obeliscoides Jeffreys, 1885:55, pl. 6 figs 4-4a.

Type material: Syntypes in BMNH and USNM (listed by Warén 1980:26).

Type locality: PORCUPINE 1870 st 16, 17, 17a, 39°39' to 39°55' N, 09°39' to 09°56' W, 1092-1993 m (off Portugal).

Material examined: The type material and --29 shells and fragments from the type locality (coll. Sykes, BMNH);- TRAVAILLEUR 1882, dr 41, 33°06' N, 09°22' W, 1900 m, 3 fragm; MONACO Exp 1902 cruise (the Azores), no precise data, 3 shs; MONACO Exp st 1116, 31°43' N, 30°07' W, 2165 m, 2 shs (Dautzenberg & Fischer 1906:44).

Distribution: Only known from the material examined, from off southwestern Europe, northwestern Africa and the Azores, bathyal.

Remarks: Krachia obeliscoides resembles *K. cossmanni*, but has three spiral cords instead of two and more numerous axial ribs, generating a more reticulate sculpture. *Krachia guernei* has a coarser sculpture than *K. cossmanni*.

Krachia guernei (Dautzenberg & Fischer, 1896) Figs 1349-1350

Cerithiella guernei Dautzenberg & H. Fischer, 1896:447, pl. 18 fig. 8; Dautzenberg 1927:112, pl. 1 fig. 29.

Type material: Lectotype, here selected, the shell figured by Dautzenberg and Fischer, in MOM.

Type locality: MONACO Exp st 553, 37°43' N, 25°05' W, 1385 m (Azores).

Material examined: The lectotype and --MONACO Exp st 233, 38°33' N, 28°09' W, 1300 m, 13 shs; st 234, 39°02' N, 27°55' W, 454 m, 1 sh; st 683, 38°20' N, 28°05' W, 1550 m, 1 sh; st 1349, 38°36' N, 28°06' W, 1250 m, 1 sh; CHALLENGER st 75, 38°38' N, 28°29' W, 825-920 m (NMW). Dautzenberg (1927) also cited material from MONACO Exp st 719 (in MOM), but the specimens were too broken to be determined.

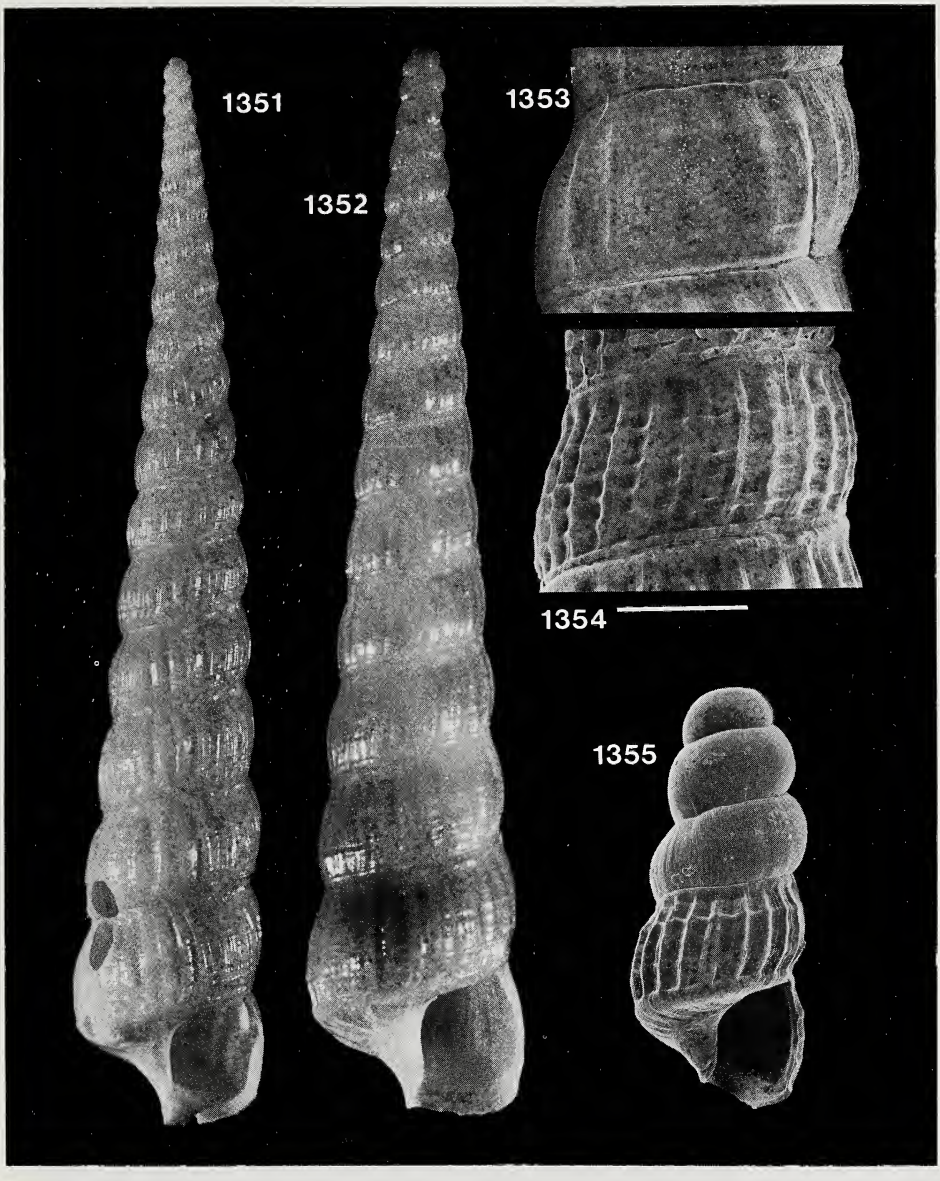
Distribution: Only known from the material examined, from the bathyal zone of the Azores.

Remarks: A worn shell from CANCAP st 2.160, 17°36' N, 17°39' W, 550 m (RMNH), off northwestern Africa, resembles Azorian shells of *K. guernei*, but differs in having a weak additional subsutural spiral cord. We abstain from identifying it.

Genus *EKTONOS* gen. n.

Type species: Cerithiopsis turbonilloides Dautzenberg & Fischer, 1896.

Diagnosis: Cerithiopsids with slender, turritelliform, fragile shell. Dominant axial sculpture does not form tubercles when intersecting spiral sculpture; columella almost straight, with indistinct si-



Figures 1351-1355. *Ektonos turbonilloides*. **1351-1352**, INGOLF st 90, 25.3 mm and 15.7 mm. **1353**, detail of sculpture, INGOLF st 90. **1354**, detail of sculpture, CHALLENGER 2 st 177. **1355**, INCAL st WS01, newly hatched juvenile, 2.2 mm.
Scale line 1mm.

phonal notch. Radula with very large central tooth, large median cusp; lateral and marginal teeth identical, except in size, and equipped with a big central and two smaller outer cusps.

Etymology: Greek Tonos, a tune, and prefix ek-, out of, meaning that this cerithiopsid genus is not in harmony with other cerithiopsid genera.

Remarks: The radula of *C. turbonilloides* (Fig. 1278-9) is different from other radulae known in the family. The type species of genera with unknown radula have different shells.

Ektonos turbonilloides (Dautzenberg & Fischer, 1896)
Figs 1278-1279, 1293, 1351-1355

Cerithiopsis(?) turbonilloides Dautzenberg & H. Fischer, 1896:443, pl. 18 fig. 5; Dautzenberg 1927:108, pl. 1 fig. 25.

Type material: Lectotype, here selected, the shell figured by Dautzenberg & Fischer, in MOM.

Type locality: MONACO Exp st 233, 38°33' N, 28°09' W, 1300 m (Azores).

Material examined: The type material and --MONACO Exp st 233, 1 sh (paralectotype, IRSN); INGOLF st 10, 64°24' N, 28°50' W, 1484 m, 2 shs; st 19, 60°29' N, 34°14' W, 2949 m, 1 sh; st 78, 60°37' N, 27°52' W, 1505 m, 3 shs; st 90, 64°45' N, 29°06' W, 1070 m, 8 shs; CHALLENGER 2 st 177, 57°18' N, 10°16' W, 2200 m, 1 spm, 1 sh (RSM 1976004.11501); INCAL st WS1, 50°19' N, 13°08' W, 2540-2550 m, 1 very young spm; 61°37' N, 28°56' W, 1100-1280 m, fragm (Clarke 1974:6, as *Epitonium obtusicostatum* in part).

Distribution: Only known from the material listed above, from southeast of Greenland, southwest and south of Iceland, the Rockall Trough and the Azores, in bathyal depths.

Remarks: Dautzenberg (1927) listed *C. turbonilloides* from st 234 (an error for st 233 = HIRONDELLE 1888, st 69 of the earlier list) and from st 211 (= HIRONDELLE 1888, st 47 of the earlier list; material not found).

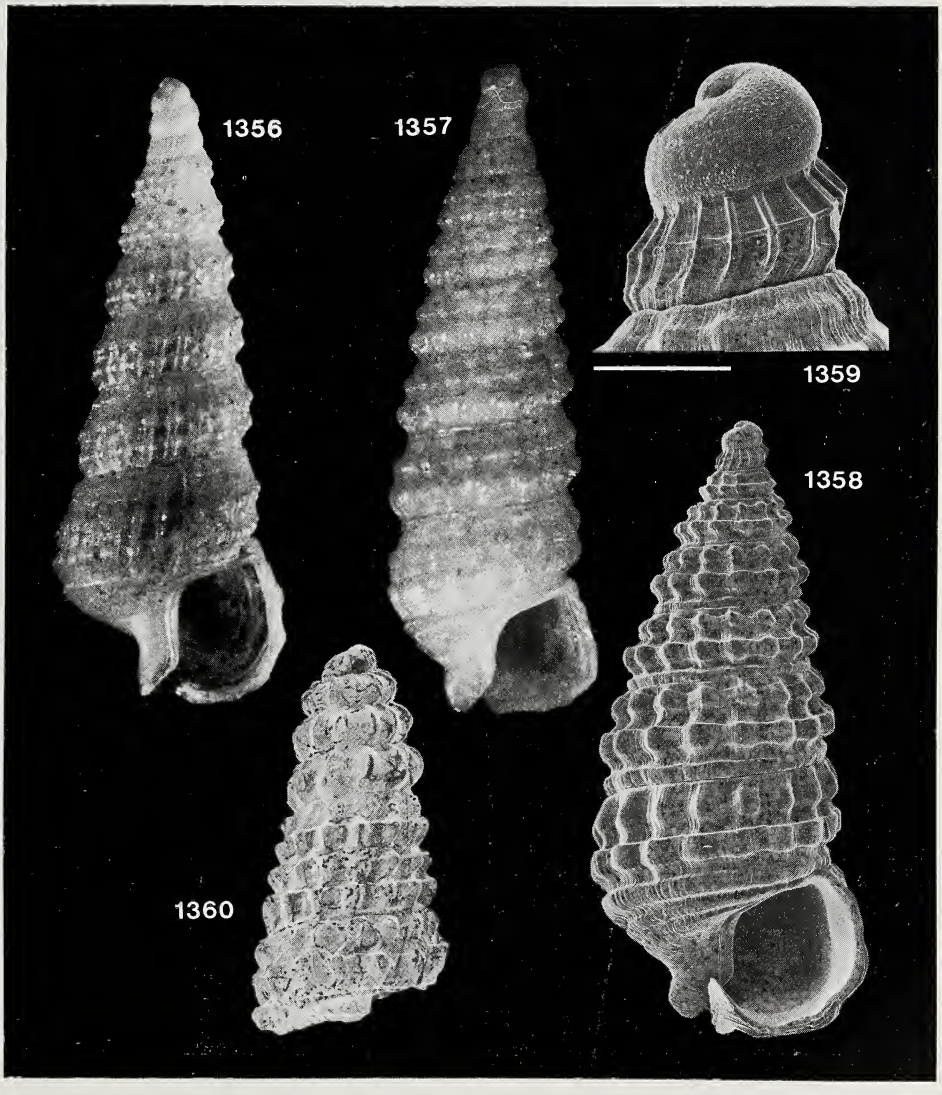
The few specimens known show a remarkable variation in the spiral sculpture, from almost exclusively axial sculpture in the INGOLF shells (Fig. 1353) to strong spiral cords over the axial ribs in the specimens from CHALLENGER 2 (Figs 1354). The lectotype has an intermediate sculpture and all specimens have a protoconch of several smooth whorls. We do not, however, doubt that they are conspecific.

Genus *ONCHODIA* Dall, 1924

Laskeyia (Onchodia) Dall, 1924:87. Type species, by original designation, *Laskeyia benthica* Dall, 1924. North America, off Georgia.

Remarks: Laskeyia benthica (Fig. 1357) has never been figured, which is probably the reason why the genus has remained unused. It was placed in the synonymy of *Cerithiella* by Wenz (1940), but Marshall (1978:61) suggested *Onchodia* to belong to the Metaxiinae.
Laskeyia benthica and *Cerithiopsis valeriae* Giusti are so similar conchologically that we are con-

vinced that they are congeneric. The radula of *O. valeriae* (Fig. 1283) has 7 teeth per row. The central, lateral and first marginal are very similar and each have 3 short strong cusps. The outer marginal is broader, and has 7 short, strong cusps. There is actually a general smilarity between the radulae of *Metaxia* and *Onchodia*, but *Onchodia* is taenioglossate. In *Metaxia*, the radula has 19-29 teeth per row (Marshall 1977, Bouchet 1985), each tooth with 3-4 strong cusps and the outermost marginal teeth are reduced in size. We believe that the rhinioglossate type of radula may have evolved several times from taenioglossate cerithiopsids. Therefore Marshall's (1978) suggestion, about relations to *Metaxia*, may nevertheless be correct. We prefer, however, to maintain a traditional classification, with *Onchodia* placed in the Cerithiopsidae.



Figures 1356-1360. 1356, *Krachia cossmanni*, MONACO Exp st 233, 5.9 mm. **1357**, *Onchodia benthica*, holotype, 5.9 mm (USNM 108344). **1358-1359**, *Onchodia valeriae*, BALGIM st DW50, 4.5 mm, scale line 200 m. **1360**, *Triforis* sp., MONACO st 112, 2.2 mm.

Shells of *Onchodia* are characterized by their sculpture of two rows of tubercles on the apical teleoconch whorls, of which the abapical row is stronger. There are two or three smooth cords on the base of the body whorl. The columella is thickened and the outer lip expanded. A narrow cord is present at the base of the siphonal canal and may be a generic character. So far the additional species of *Onchodia* known to us (undescribed Indo-Pacific species) have paucispiral protoconchs. Most of the West Atlantic species described by Dall (1927) in *Onchodia* do not belong there (type material in USNM examined).

Onchodia valeriae (Giusti, 1987) Figs 1283, 1290, 1358-1359

Cerithiopsis valeriae Giusti, 1987:14, textfigs.

Type material: Holotype in Museo Provinciale di Storia Naturale, Livorno, Italy (not seen).

Type locality: Off the Chafarinas Island (Mediterranean coast of Morocco), 120-180 m.

Material examined: --BALGIM st DR40, 35°50' N, 06°09' W, 362 m, 4 spms and shs; st DR49, 35°53' N, 06°33' W, 518-524 m, 3 spms and shs; st DW50, 35°53' N, 06°32' W, 518-526 m, 3 spms; st DW132, 35°26' N, 04°19' W, 170 m, 1 sh (all MNHN); Alboran Sea, 160 m, 6 shs (coll. Bogi).

Distribution: Only known from the Alboran Sea and the Ibero-Morocan Gulf, deep shelf to upper bathyal.

Remarks: Onchodia benthica (Fig. 1357) differs from *O. valeriae* (Fig. 1358) by being more slender, and having a discrete spiral microsculpture that is lacking in *valeriae*. Mature specimens of *valeriae* have three smooth cords on the base, while there are only two in *benthica*. The diameter of the first protoconch whorl is 280-320 μm in *valeriae*, 450-470 μm in *benthica*.

Genus *CERITHIOPSIS* Forbes & Hanley, 1851

Cerithiopsis Forbes & Hanley, 1851:364. Type species, by original designation, *Murex tubercularis* Montagu, 1803. Great Britain.

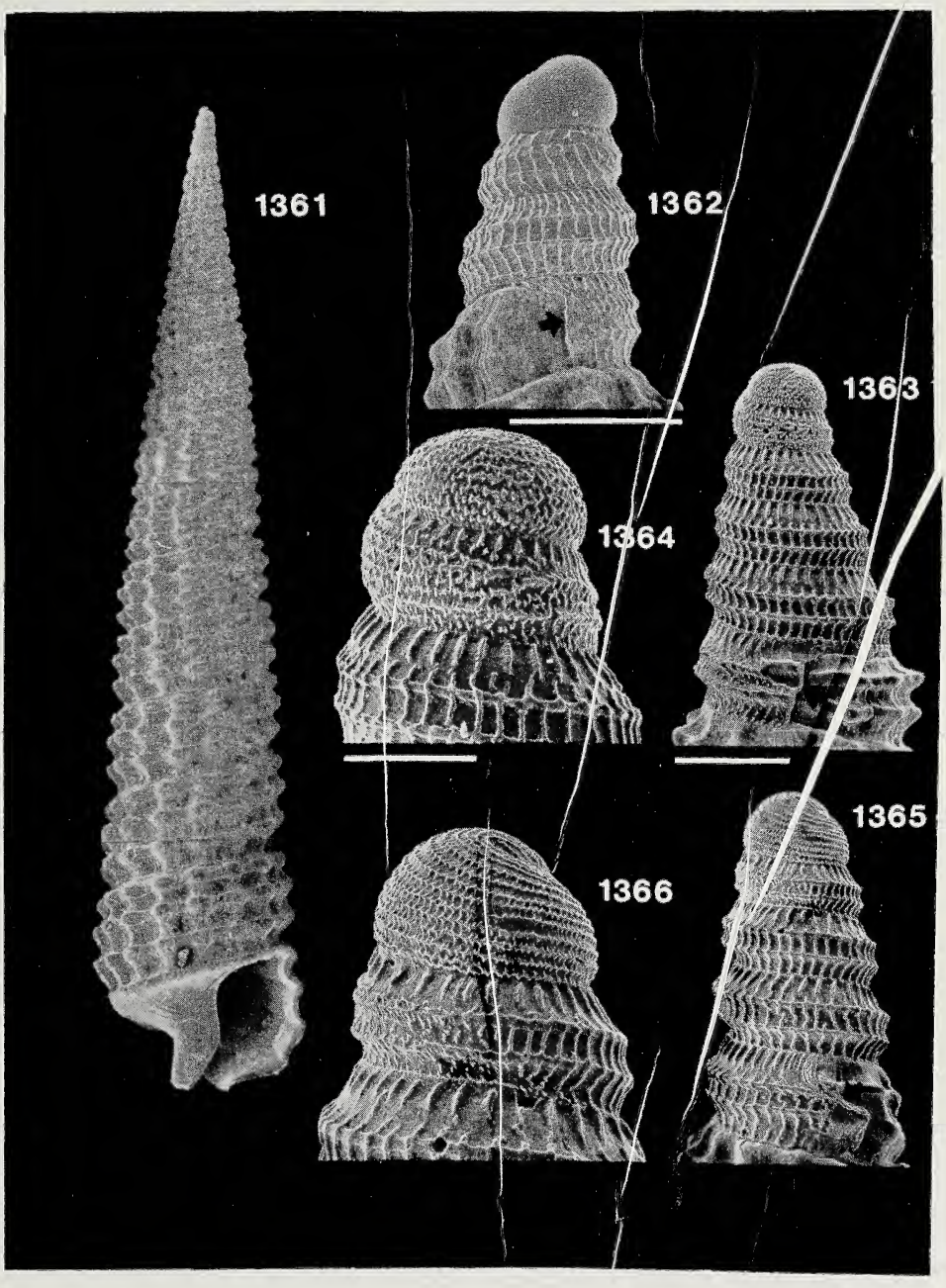
Remarks: The type species of *Cerithiopsis* differs from *C. atalaya* in protoconch and teleoconch characters and they are certainly not congeneric. The radula of *C. atalaya* is not known. *"Cerithiopsis"* is used only as a provisional placement until live-taken specimens give an opportunity to examine the radula.

"Cerithiopsis" atalaya Watson, 1885 Figs 1361-1362

Cerithiopsis atalaya Watson, 1885:94, fig. 9.

Type material: lectotype, here designated from 25 syntypes, in NMW; 4 syntypes in BMNH (coll. Norman ex Watson).

Type locality: Madeira, 0-90 m.



Figures 1361-1366. 1361, *"Cerithiopsis" atalaya*, THALASSA st Z392, 12.8 mm. **1362**, *"C." atalaya*, off Calvi, Corsica, 100-120 m. **1363-1364**, *Strobiligera brychia*, BALGIM st DW132. **1365-1366**, *Strobiligera flammulata*, BALGIM st DW132.

Scale lines 100 μm (1364, 1366), 200 μm (1362, 1363, 1365).

The arrows indicate the protoconch - teleoconch demarcation.

Material examined: The type material and --Calvi, Corsica, 110-130 m, 1 juv. sh; Secche delle Vedove, Capraia, Italy, 120 m, 1 sh (coll. di Paco); Punta Biancha, Adriatic, 3 shs (coll. Monterosato ex Kleciak); Bocche di Bonifacio, 100-120 m, 1 sh (coll. Nofroni); Isola Gorgona, Tuscan archipelago, Italy, 400 m, 1 sh (coll. Nofroni); Alboran Sea, 75-200 m, 2 shs (coll. Templado, Nofroni); --SEAMOUNT 1 st DW04, 36°33' N, 11°34' W, 93-96 m, 1 sh; THALASSA st Z392, 47°35' N, 07°01' W, 390 m, 1 sh; off Abidjan, Ivory Coast, 1 sh (MNHN, leg. LeLoeuff); --Ambrizete, Angola, 45 m, 2 shs (MNHN, leg. Gofas).

Distribution: From the northern part of the Bay of Biscay along the eastern Atlantic as far south as Angola. In the Mediterranean it occurs in the western basin and the Adriatic, on the mid- and deep shelf.

Remarks: The type lot contained only a single specimen with a good protoconch, which is designated as lectotype. Most other specimens are in poor condition and some may not be conspecific.

"Cerithiopsis" atalaya is a very rare species, except perhaps locally in Madeira where Watson dredged rather many shells. Specimens with protoconchs are easy to identify, but shells with broken apex are almost inseparable from *"C." scalaris*, which also has a single smooth cord encircling the rather concave base.

Shells from the Alboran Sea and West Africa have a brownish, conical shell and a conical protoconch, while shells from Madeira have a uniformly reddish brown, rather pupoid shell with a styloid protoconch. Other specimens from the Mediterranean appear to be intermediate, but more material is needed before this variation can be evaluated.

Genus *LAIOCOCHLIS* Dunker & Metzger, 1874

Laiochochlis Dunker & Metzger, 1874a:7 (incorrect original spelling). Type species, by monotypy, *L. pommeraniae* Dunker & Metzger, 1874. Southern Norway.
Sasamocochlis Gründel, 1980:253. Type species, by original designation, *Laiocochlis sasamorii* Kuroda, 1943. Northern Japan. (***Syn. nov.***)

Remarks: Dunker & Metzger published no less than four different spellings of the generic name. In the preliminary latin diagnosis (1874a), it is spelled *Laiochochlis*; in the full description (1874b), it is spelled *Laeochochlis* in the text, and *Laiocochlis* on the plate; and finally it was spelled *Laeocochlis* by Dunker & Metzger (1875) in the expedition report. Kobelt who edited "Nachrichtsblatt" and "Jahrbücher", which serials contained the two earliest descriptions, commented on this (in von Martens 1875:116). He stated *"Laiocochlis"* to be spelling originally intended by the authors in their manuscript. Heppell (1991) petitioned the ICZN to stabilize the spelling *"Laeocochlis"*, contrary to the original intention. Pending a decision by the Commission, we use *Laiocochlis* as suggested by us (Bouchet & Warén, 1991).

Gründel (1980) separated *Sasamocochlis* from *Laiocochlis* on the basis of differences in sculpture of the protoconch (axial and spiral lines forming a reticulate pattern in *Sasamocochlis*). Considering the intraspecific variation of such sculpture in *L. sinistrata*, we do not find this character important enough to warrant distinction (each genus has a single Recent species), and synonymize *Sasamocochlis* with *Laiocochlis*.

Laiocochlis sinistrata (Nyst, 1835) Figs 1281, 1288, 1367-1370

Cerithium sinistratum Nyst, 1835:28, pl. 5 fig. 5.
Triforis macandraeae A. Adams, 1856:1.

Triforis nivea M. Sars, 1859:85.
Laiochochlis pommeraniae Dunker & Metzger, 1874a:7; 1874b:147, pl. 7 fig. 3.

Type materials: C. sinistratum: neotype selected by Glibert (1958a) in IRSN; *L. pommeraniae*: syntypes probably the 2 shells in Zoologisches Museum, Berlin, figured by Gründel (1980:fig. 34); Dunker & Metzger (1874b) list 3 syntypes, of which one live taken might have been destroyed for radula preparation.

Type localities: C. sinistratum, neotype from "Scaldisien" (Plio-Pleistocene according to Glibert 1957) of the Austruweel sands, Belgium; *T. macandraeae*, "ad. litt. Scandinaviae" = coasts of Scandinavia; *T. nivea*, Bergen, Norway, 220-260 m; *L. pommeraniae*, southern Norway, between Lindesnaes and Listerfjord, 195 m, and west-southwest of Haugesund.

Material examined: About 200 specimens and shells from the northeast Atlantic part of the distribution area. Southernmost occurences: PORCUPINE 1869 st 23a, 56°13' N, 14°18' W, 764 m, 1 sh (BMNH 85.11.5.2672); st 65, 61°10' N, 02°21' W, 628 m, 5 shs (BMNH 85.11.5.2665-8, 2518); -- BIOFAR st 019, 62°12' N, 04°25' W, 277 m, 1 spm; st 61°54' N, 05°04' W, 225 m, 3 spms; st 033, 61°43' N, 05°51' W, 351 m, 2 shs; st 61°38' N, 05°38' W, 322 m, 2 spms; st 190, 62°45' N, 06°43' W, 250 m, 2 spms; st 335, 61°50' N, 10°30' W, 997 m, 2 shs; st 341, 62°07' N, 09°45' W, 710 m, 2 shs; st 344, 62°39' N, 08°39' W, 498 m, 2 spms.

Distribution: From the Barents Sea (Murmansk, Herzenstein 1885) along the Norwegian coast (fjords and outer shelf) to the westernmost Skagerrak (numerous records in the literature and material examined in ZMB, ZMO, ZMC, SMNH), 55-700 m, mostly 200-500 m. The distribution continues westwards along the Shetland-Faroe ridge (Jeffreys 1885) to Iceland (Thorson 1941, Oskarsson 1982), but it is not known from eastern Greenland. In the western Atlantic it appears to live in deeper water, from Davis Strait to Newfoundland, in 475-1420 m (Dautzenberg & Fischer 1912, Clarke 1974).

Remarks: In western Europe the southernmost records are those by Sykes (1925:185) from PORCUPINE 1870 st 8 (48°13' N, 09°11' W, 470 m) and st 9 (48°06' N, 09°18' W, 990 m), southwest off the British Isles. We have examined this material in BMNH which consists of three old, worn fragments which may be glacial fossils. The species was not recorded by Massy (1930) from the Irish continental slope, and the southernmost reliable records are off western Scotland.

This species is more well known as *L. granosa* (Wood, 1848), an upper Pliocene fossil, which was renamed *L. woodi* by Altena (1954) because of homonymy with *Cerithium granosum* Borson, 1821. Glibert (1958a) distinguished between *L. sinistrata*, with a teleoconch sculpture of only spiral cords, and *L. woodi*, with a teleoconch sculpture of both spiral cords and axial riblets forming an almost square reticulation. He also compared two Recent Norwegian shells and found them to be identical with *L. sinistrata*. Glibert (1958a) listed *L. sinistrata* from the Luchtbal, Kattendyk and Austruweel sands, all of "Plio-Pleistocene" ("Scaldisien") age. The faunal assemblages of these sands (Glibert 1957, 1958b) contain cold water species now living in northern Europe (*Calliostoma occidentalis* is listed as common) as well as warm temperate or even subtropical species. Obviously the deposits have been reworked.

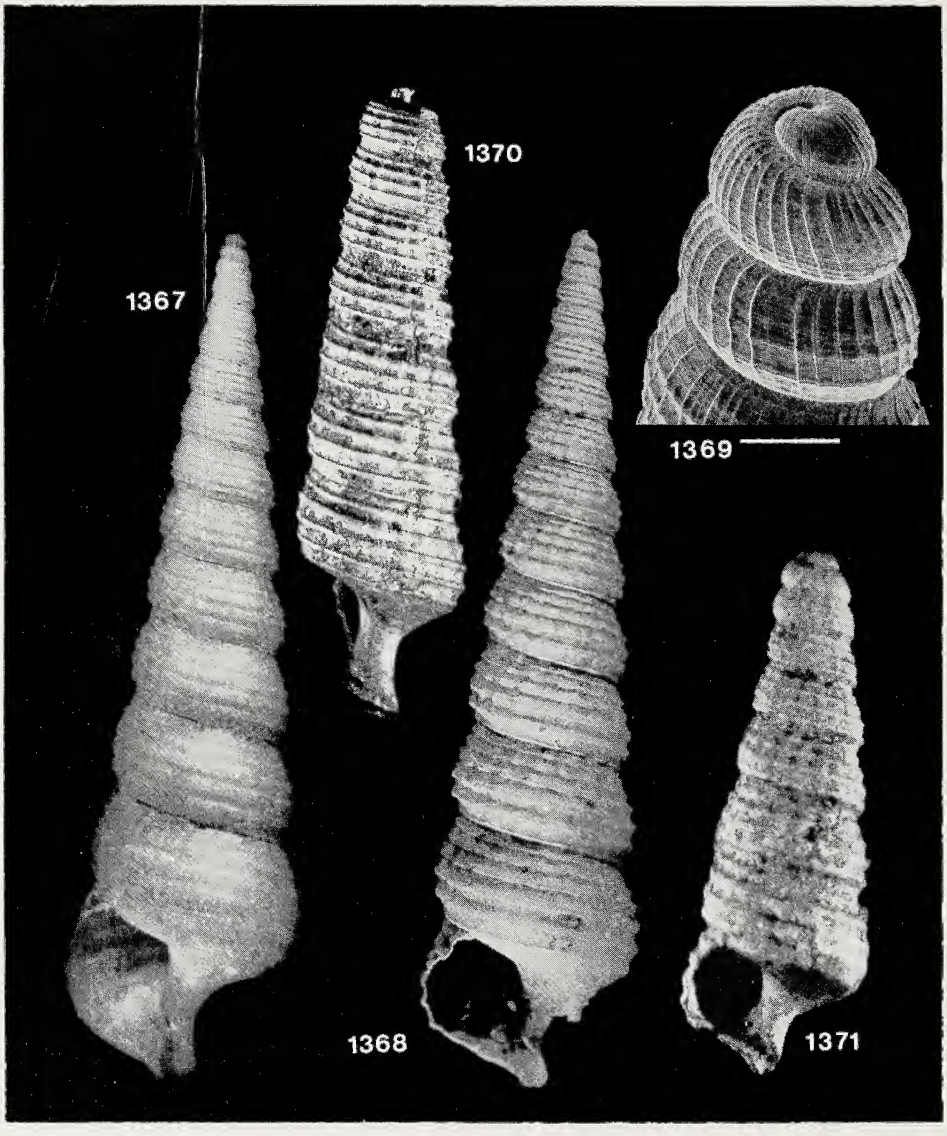
We have examined a few shells of *Laiocochlis* from British as well as Belgian deposits (Figs 1370-1371) but we have seen too few specimens to comment on their specific distinction. We do, however, want to draw attention on the variation in the Norwegian population, where specimens with only spiral sculpture occur together with specimens with axial and spiral sculpture (Figs 1367-1368).

The axial ribs however are broad and do not form a fine reticulate sculpture as has been figured in fossil *L. woodi*.

A specimen from southwestern Norway had spicules of the sponge *Hamacantha* (det. O. Tendal) in the faeces.

Several egg-capsules have been found by Warén off Korsfjorden, western Norway, in January and February. They are laid single and free on the bottom, are oval, about 5 x 3.5 mm, with a sim-

ple, thin wall with some particles of bottom material attached. They contain a single embryo with about 2.5 whorls and the development thus is lecitotrophic.



Figures 1367-1371. Genus *Laiocochlis*. **1367**, *L. sinistrata*, Bergen area, NW of Marsteinen, 256-276 m, 31.2 mm. **1368**, *L. sinistrata*, Bredafjord, 28.5 mm. **1369**, *L. sinistrata*, Bergen, scale line 0.5 mm. **1370**, *L. sinistrata*, Bassin Van de Vin, "Scaldisien inférieur", 24.9 mm (IRSNB 16416). **1371**, *L. woodi*, Sutton, Coralline Crag (BMNH Paleontology G1907), 7.8 mm.

Family TRIFORIDAE

The family name Triforidae Jousseaume, 1884 is based on an erroneous subsequent spelling of *Triphora* de Blainville, 1828, the type genus of Triphoridae Gray, 1847. The names *Triforis* Deshayes, 1834 and Triforidae will have to be abandonned, but are here provisionnally kept in the sense of Marshall (1980), awaiting the result of work on the systematic position of the family (Bouchet & Warén, in prep.).

Beside the fragments discussed below, the genus *Triforis* is known from south of the area treated in this series. *Triforis superstes* and *T. anelpistos* were both described from the Great Meteor Bank, 300-310 m (Bouchet & Fechter, 1981).

Triforis sp. Fig. 1360

Material examined: --MONACO Exp st 112, 38°35' N, 28°06' W, 1287 m, 1 fragment (Dautzenberg 1889:41, as *Bittium watsoni*); st 1349, 38°36' N, 28°06' W, 1250 m, 1 fragm.

Remarks: The two fragments belong to a species which has tuberculate teleoconch sculpture (Fig. 1360). This shows their specific distinctness from the two species from Great Meteor Bank. They both have axial ribs with swollen but not distinctly set off tubercules.

Family TRIPHORIDAE

The family Triphoridae is represented in the Northeast Atlantic deep-sea by three species of *Strobiligera*, two of which are described as new. The dextral *Metaxia abrupta* (Watson, 1880) was recorded from deep water in the Azores, but a record from BIACORES st 61 in 77 m indicates that it is most probably a shallow-water species. (From other parts of the world the genus *Metaxia* is known only from shallow water.) *Metaxia abrupta* was figured by Bouchet (1985) and we refer there for information on that species.

Genus *STROBILIGERA* Dall, 1924

Strobiligera Dall, 1924:89. Type species, by original designation, *Triforis ibex* Dall, 1881. Caribbean.

Remarks: Massy (1930:301) recorded *Strobiligera bigemma* (Watson, 1880), a Caribbean species, from off Ireland. We have not been able to check this material (depository unknown; not in National Museum of Ireland, J. Holmes *in litt.*), but we strongly suspect the record to be based on *Strobiligera brychia*.

Strobiligera brychia (Bouchet & Guillemot, 1978) Figs 1363-1364, 1372

Triforis aspera Jeffreys, 1885:58, pl. 6 figs 7-7a. (not *Triforis asper* Deshayes, 1864).
Triforis asper var. *decorata* Locard, 1897:385.
Triphora brychia Bouchet & Guillemot, 1978:355 *nom. nov.* for *Triforis aspera* Jeffreys, 1885.

Type material: Syntypes in USNM and BMNH (listed by Warén 1980:25).

Type locality: Not restricted. Jeffreys listed seven PORCUPINE stations, from the coasts of Portugal and North Africa, in 170-1825 m.

Material examined: The type material and:

--Bay of Biscay: THALASSA st W422, 44°04' N, 06°59' W, 700-850 m, 1 sh; st Y403, 40°37' N, 09°20' W, 435 m, 1 sh; st Z427, 48°27' N, 09°48' W, 330 m, 1 sh; st Z428, 48°27' N, 10°50' W, 850 m, 1 spm; 45°18' N, 03°10' W, 400-600 m, 1 sh, Lagardère leg.; BIACORES st 257, 47°57' N, 07°52' W, 335-355 m, 1 spm, 1 sh.

--Off SW Europe: BALGIM st DR37, 36°18' N, 07°15' W, 860-868 m, 7 shs + fragms; st DR40, 35°50' N, 06°09' W, 362 m, 96 shs + fragms; st DR49, 35°53' N, 06°33' W, 518-524 m, 31 shs; st DW50, 35°53' N, 06°32' W, 518-526 m, 5 shs; SEAMOUNT 1 st DW05, 36°32' N, 11°38' W, 180 m, 1 spm; st DW08, 36°29' N, 11°37' W, 470-485 m, 4 shs; st DE09, 36°32' N, 11°38' W, 350-360 m, 1 sh; st DE10, 36°27' N, 11°35' W, 500-545 m, 2 shs; st DW15, 36°33' N, 11°29' W, 300-330 m, 2 shs; st DW16, 36°33' N, 11°33' W, 255-265 m, 1 spm, 3 shs; --st CP20, 36°34' N, 11°30' W, 305-320 m, 4 spms, 1 sh; st DW21, 36°35' N, 11°28' W, 460-480 m, 1 spm, 6 shs; --st CP28, 36°38' N, 11°30' W, 605-675 m, 1 sh; st DW38, 36°42' N, 14°17' W, 235-245 m, 3 shs; st DW43, 36°45' N, 14°17' W, 260-285 m, 6 shs; st DW45, 36°46' N, 14°18' W, 315-335 m, 20 shs; st DW60, 36°43' N, 14°17' W, 240-255 m, 1 spm, 2 shs; st DW63, 35°15' N, 15°35' W, 630 m, 1 sh; st DE82, 33°48' N, 14°24' W, 320-400 m, 1 spm; st DE98, 35°03' N, 12°55' W, 300-325 m, 5 shs; st DW108, 42°51' N, 11°53' W, 1110-1125 m, ca.50 shs and fragms; st DW111, 42°40' N, 11°36' W, 675-685 m, 20 shs and fragms; st DW116, 42°52' N, 11°51' W, 985-1000 m, ca.80 shs and fragms; Galicia Bank off NW Spain, 1 spm, leg. Rolan.

--The Azores: TALISMAN dr 129, 38°00' N, 27°03' W, 2155-2220 m, 2 shs; MONACO Exp st 233, 38°33' N, 28°09' W, 1300 m, 1 fragm; st 234, 39°02' N, 27°55' W, 454 m, 1 fragm; st 553, 37°43' N, 25°05' W, 1385 m, 3 fragms; st 719, 39°11' N, 29°06' W, 1600 m, 5 fragms; st 1349, 38°36' N, 28°06' W, 1250 m, 2 shs; st 2210, 39°25' N, 31°22' W, 1229 m, 1 sh; st 2214, 39°26' N, 31°22' W, 650-914 m, 1 sh, 3 fragms; BIACORES st 39, 37°43' N, 27°03' W, 420 m, 1 sh.

--Off northwestern Africa: CANCAP st 3.068, 30°07' N, 15°53' W, 310 m, 1 spm; st 4.116, 28°26' N, 17°51' W, 420 m, 1 sh; VANNEAU st 37, 33°59' N, 07°50' W, 155 m, 2 worn shs; st 44, 34°54' N, 07°54' W, 145 m, 1 fragm; JEAN-CHARCOT Madère st 49, off Madeira, 450-500 m, 1 juv. sh; off Madeira, 300-340 m, 1 sh.

--Mediterranean: BALGIM st DW132, 35°26' N, 04°19' W, 170 m, 2 juv. shs; Alboran Sea, 75-200 m, 1 sh (coll. Templado).

Distribution: From the northern part of the Bay of Biscay along the West European continental slope as far south as Morocco, also in the Azores. In the Mediterranean, it is known from the southern part of the western basin, as far east as the Sicilian Channel. Depth range 140-2220 m. In the southwestern Mediterranean (and on the banks off Portugal) it occurs more shallow (deep shelf) than in the Atlantic, where it is found on the continental slope.

Remarks: When the replacement name *Triphora brychia* was proposed, Locard's varietal name had been overlooked as a possible replacement name. The name *decorata* Locard, 1897 belongs to *Strobiligera* and is not a secondary homonym of *Cerithium decoratum* C.B. Adams, 1850, which is a *Triphora* s.l. However Locard's name has never been treated as an available name, nor cited in any form after 1897, and was clearly meant to be infrasubspecific according to ICZN art. 45g. Therefore *Triphora brychia* remains the valid name.

The radula was figured by Bouchet (1985).

Strobiligera lubrica sp.n. Figs 1284-1285, 1287, 1374

Type material: Holotype in MNHN.

Type locality: BIOCYAN 2, Cyana dive 18, 47°32' N, 08°28' W, 2000 m (Bay of Biscay).

Description: Shell (Fig. 1374) large, conical, slender, consisting of 15 whorls. Protoconch and earliest part of teleoconch corroded. Whorls moderately convex, suture shallow. Sculpture consisting of two broad spiral cords that intersect with low and indistinct prosocline axial ribs, forming granules at the intersections. Only spirals 2 and 3 (for terminology, see Marshall 1983) are present, spiral 1 is reduced to an indistinct subsutural swelling, also on body whorl. A finer sculpture of incremental lines is also present. There are 4 smooth cords on the base of the shell, the adapical one remaining visible on the spire just above the suture. The shell has been broken and repaired 1/3 of a whorl behind the peristome, so that the initial pattern of spiral sculpture has been disrupted. However, before the scar, spiral 3 starts to divide and one additional spiral appears above and below it. Siphonal canal short, broad, open. Aperture as high as broad. Inner lip regularly convex, forming a thick callus on the columella. Outer lip chipped at the base, so that its angular appearance is probably exaggerated. Shell polished, white, with orange-brown base, including the four basal cords; tip of siphonal canal lighter; inner lip white.
Dimensions: height 14.9 mm, breadth 4.2 mm; aperture height 2.6 mm, breadth 2.1 mm.
Radula (Figs 1284-5) with about 50 teeth per row. Central, lateral and marginal teeth not differentiated, with two slender claw-shaped cusps; outer marginal with three cusps.
Operculum (Fig. 1287) multispiral and light tan.

Remarks: Strobiligera lubrica differs from the two other northeastern Atlantic species by being comparatively broader, and having a polished shining shell and a sculpture with fewer, more spaced, tubercles. Despite being mature (outer lip expanded) and its large size, the subsutural row of granules ("spiral 1" of Marshall 1983) remains undeveloped, even on the body whorl. In *S. flammulata* and *S. brychia*, on the contrary, it is always present on the body whorl, although sometimes weakly developed in small, adult specimens. The base of the body whorl has four very distinct smooth basal cords, while in *brychia* there are only two such cords. In *S. lubrica* there are also two additional rows of granules on the body whorl, one above and one below spiral "3", which are absent in *brychia* and *flammulata*. In *S. lubrica* the shell is white while all four basal cords and the suprasutural spiral rib are orange-brown. In *brychia* the shell is light tan, with only the abapical part of the base orange-brown, and only below the cords. The variegated colour pattern of *S. flammulata* is readily distinguishable.

We do not know if the number of teeth per radular row (50 in *lubrica* vs. 36 in *brychia*) is a significant difference since it is known to vary considerably between in different populations of triphorids (Bouchet 1985).

Strobiligera flammulata sp.n. Figs 1365-1366, 1373

Strobiligera n.sp. A: Bouchet 1985:32, fig. 25.

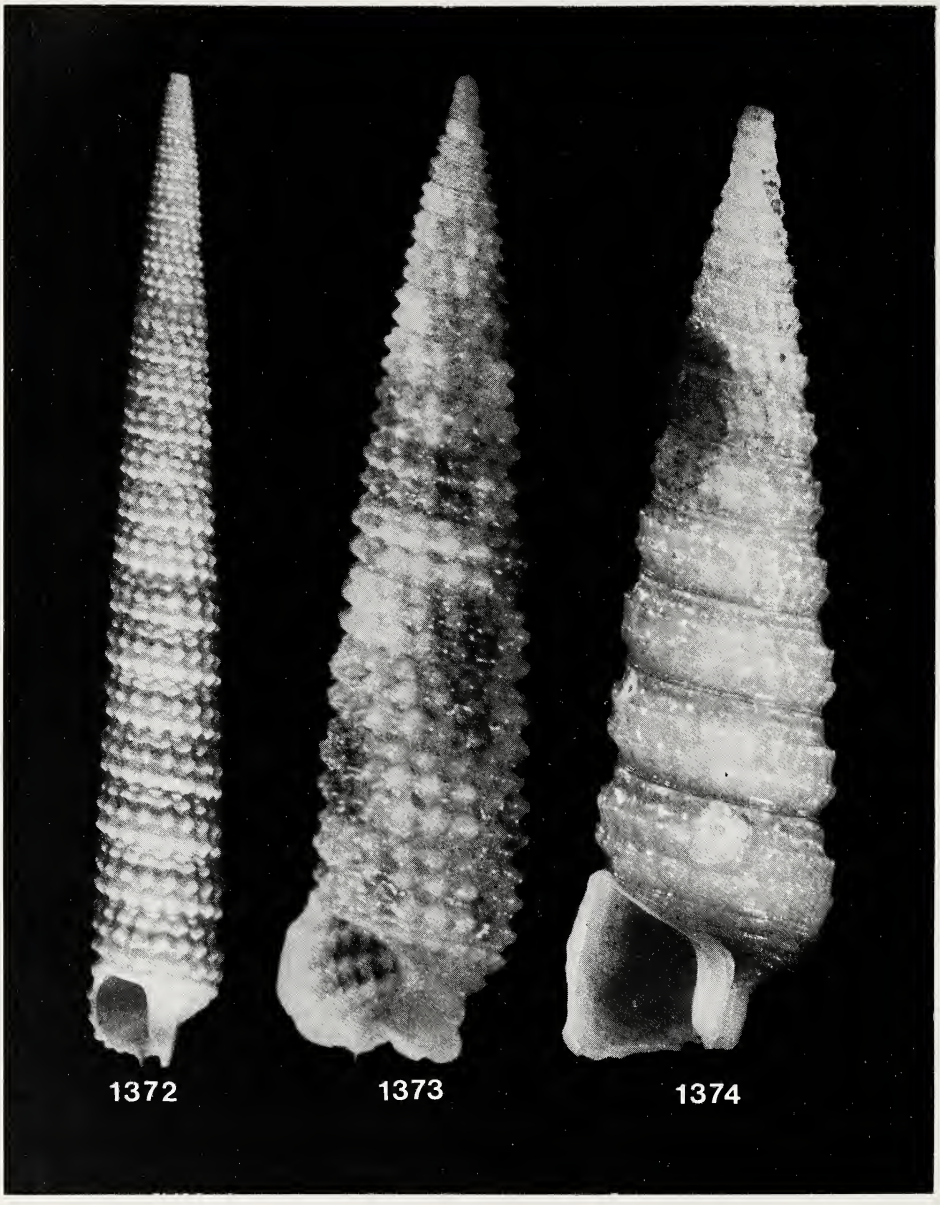
Type material: Holotype in Museo di Zoologia, Universita di Bologna.

Type locality: Acitrezza, north of Catania, eastern Sicily, 40 m, leg. G. Spada.

Material examined: The holotype and --BALGIM st DR40, 35°50' N, 06°09' W, 362 m, 3 shs; st DW132, 35°26' N, 04°19' W, 170 m, 1 very young shell (Figs 1365-1366; subsequently lost); SEAMOUNT 1 st DW08, 36°29' N, 11°37' W, 470-485 m, 1 sh; st DE10, 36°27' N, 11°35' W, 500-545 m, 1

sh; --Alboran Sea, 75-200 m, 2 shs (coll. Templado); Aegean Sea, 180-215 m, 1 sh (USNM 186507); --Tuscan archipelago, deep shelf, 1 sh (coll. Piani).

Distribution: The deep shelf and upper slope of the southern Mediterranean and the Ibero-Moroccan Gulf, to the Gorringe Bank.



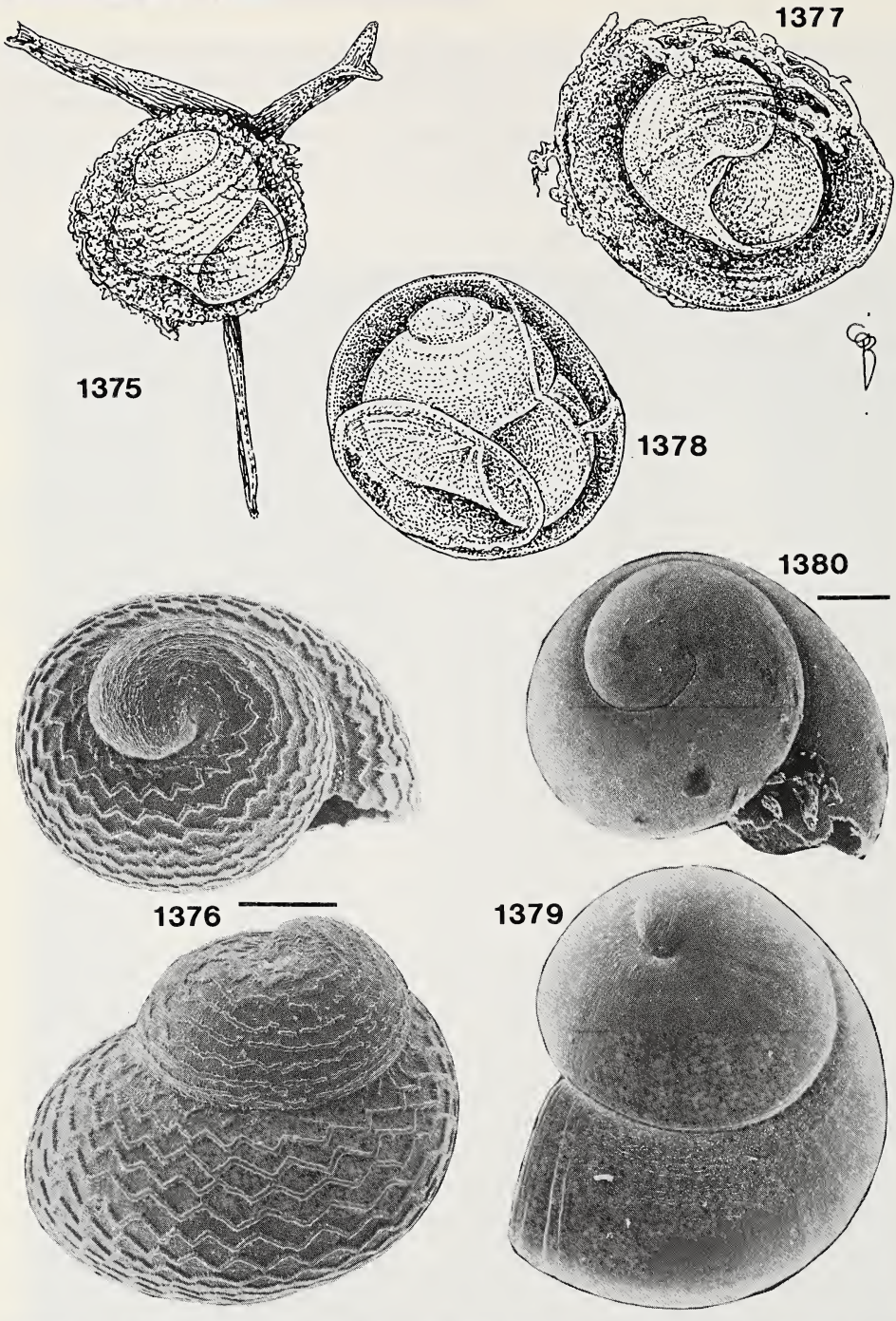
Figures 1372-1374. Genus *Strobiligera*. **1372**, *S. brychia*, J. CHARCOT Madère st 29, 300-340 m, 29.5 mm. **1373**, *S. flammulata*, holotype, 8.95 mm. **1374**, *S. lubrica*, holotype, 14.9 mm.

Description: Shell (Fig. 1373) high, slender, consisting of 3 protoconch and 15 teleoconch whorls. Protoconch styloid, with convex whorls. Protoconch I (Fig. 1366) with 13 spiral lines with short radiating axial trabeculae forming a fine reticulation. Protoconch II (Fig. 1365) with two strong spiral keels and slightly sigmoid axial ribs, interrupted apically above adapical keel, and forming with the spiral keels a sculpture of small meshes. Teleoconch whorls almost flat, suture indistinct. Sculpture consisting of three spiral cords. Spiral 2 and 3 appear first, spiny on the first teleoconch whorl, granular on second whorl. Spiral 1 appears as a smooth subsutural thread on 4th teleoconch whorl, then gradually becomes granular, and is equal to spirals 2 and 3 on body-whorl. Spiral 4 is totally covered by successive whorl, and is apparent only on base of body whorl, where it is granular. There are two additional cords on the base of the body-whorl. The adapical one is slightly undulating, but not really granular, the abapical one is smooth and situated at the base of siphonal canal. The spiral cords of the spire whorls do not duplicate behind the peristome. Outer lip a little flaring, posterior canal very shallow but distinct. Inner lip thickened. Siphonal canal short, open.

Teleoconch cream coloured with amber to brown patches. Base and siphonal canal amber. Protoconch brown.

Dimensions: height 8.95 mm, diameter 2.2 mm; aperture diameter 2.0 mm.

Remarks: S. flammulata differs from *S. brychia* by having tuberculate basal cords (smooth in *brychia*), and by its colour pattern with brown patches on lighter background. In *S. flammulata*, protoconch I has a regularly reticulate sculpture, while in *brychia* (Fig. 1363-4) the tubercles and spiral trabeculae form a loose and irregular reticulation. The adult size may also differ since the two known adult *S. flammulata* are less than 10 mm high, whereas *S. brychia* occasionally has a completely formed aperture at 12 mm, but usually develops this character at a size of 15 mm or taller. Differences from *S. lubrica* are mentioned under that species.



Figures 1375-1380. Rissoid egg-capsules and larval shells of dissected out embryos. **1375-1376**, *Alvania jeffreysi*, off Korsfjorden, Norway, 275 m, attached to a sponge spicule, diameter of capsule 0.75 mm; larval shells, scale line 100 μm. **1377**, *A. subsoluta*, off Korsfjorden, Norway, 275 m, diameter of capsule 0.8 mm. **1378-1379**, *A. porcupinae*, THALASSA st X339, diameter of capsule 0.9 mm; larval shell diameter 0.6 mm. **1380**, *Pseudosetia turgida*, off Korsfjorden, Norway, 275 m, from egg-capsule similar to fig. 1375, scale line 100 μm.

Family RISSOIDAE

The family Rissoidae contains numerous species which occur on the outer part of the continental shelf and the upper part of the slope. Few of them do, however, descend deeper than 1500 m.

Several species of rissoids described from deep water, especially from the MONACO Expeditions around the Azores, are actually shallow-water species. We had several years ago found this from a rich material taken by SCUBA and this is now documented by Gofas (1990).

The recently described rissoids from the Mediterranean were reviewed by Amati *et al.* (1990). The numerous synonyms and subgenera of the rissoid genera were listed by Ponder (1985a) in his revision of the rissoid genera of the world and we do not repeat them here.

We have largely followed Ponder's (1985) classification of the rissoids. In a few cases we have raised subgenera to generic level (*Crisilla, Pseudosetia, Manzonia*).

E.R. Sykes had prepared a manuscript on the LIGHTNING and PORCUPINE rissoids, to be published in his series of reports on the molluscs of those expeditions. This manuscript was never published, but we have had access to it (kept in the Mollusca Section of BMNH).

KEY TO THE GENERA OF RISSOIDAE AND IRAVADIIDAE

A. Teleoconch smooth except incremental lines or very fine spiral sculpture (e.g. Fig. 1626) .... B
A. Teleoconch with distinct sculpture ..... H

B. Protoconch brown ..... *Benthonella* (p. 697)
B. Protoconch colourless ..... D

D. Height more than twice the diameter ..... E
D. Height less than 1.8 times diameter ..... F

E. Shell with indistinct spiral lines ..... *Ceratia* (p. 703)
E. Shell perfectly smooth ..... *Hyala* (p. 701)

F. Shell very small (1 mm), cylindrical, pupoid, with distinct umbilicus ..... G
F. Shell of medium size (1.5-3 mm) conical, without or with poorly developed umbilicus ..... *Pseudosetia* (p. 685)

G. Aperture surrounded by a broad rim ..... *Amphirissoa* (p. 696)
G. Outer lip thickened but sharp ..... *Obtusella* (p. 693)

H. Aperture strongly opisthocline I
H. Aperture ± orthocline ..... J

I. Aperture proportionally small, spiral sculpture of uniform strength ..... *Onoba* (p. 659)
I. Aperture proportionally large, sculpture reticulate or with stronger periumbilical ribs ..... *Alvania* (p. 624)

J. Spiral sculpture dominant ..... K
J. Axial sculpture not distinctly fainter than spiral sculpture ..... N

K. Whorls flat, no umbilicus L
K. Whorls convex, umbilicus deep ..... M

L. Spiral cords of uniform strength ..... *Gofasia* (p. 668)
L. Subsutural and subperipheral spiral cords stronger ..... *Crisilla* (p. 665)

M. Aperture distinctly expanded ..... *Amphirissoa* (p. 696)
M. Aperture not distinctly expanded ..... *Obtusella* (p. 693)

N. Axial sculpture broad and evenly rounded ribs ..... O
N. Axial sculpture sharp, usually forming reticulate pattern with spiral sculpture ..... *Alvania* (p. 624)

O. Axial ribs adapically drawn out to nodules ..... *Benthonellania* (p. 679)
O. Axial ribs weaker adapically ..... P

P. Surface with very fine, uniform, and dense striae ..... sg. *Vicinirissoa* (p. 678)
P. Spiral sculpture missing or of a few spiral lines ..... Q

Q. Spiral sculpture distinctly stronger on basal area than between sutures, periostracum very thin ..... R
Q. Spiral sculpture on basal area not stronger than between sutures, fresh specimens with thick periostracum ..... *Frigidoalvania* (p. 664)

R. Ribs straight, poorly developed, and scattered ..... *Gofasia* (p. 668)
R. Ribs curved or flexuous, strong and uniformly present ..... *Pusillina* (p. 674)

Genus *ALVANIA* Risso, 1826

Alvania Risso, 1826:140. Type species, by subsequent designation (Nevill 1885:105), *Alvania europea* Risso, 1826. European.

Remarks: We have used *Alvania* in a very broad sense, and some of the species may conchologically as well fit in *Onoba*, viz. *subsoluta, verrilli, tomentosa,* and *pseudosyngenes*. The problem is that there is a continuous transition from, for example, *Alvania subsoluta*, via *A. verrilli* to *Onoba islandica* and *O. aculeus*. This "lineage" is characterized by the opisthocline aperture and the paucispiral protoconch with fine spiral lines plus additional, short spiral lines on the varix of the outer lip of the protoconch. The alternative of placing them in *Alvania*, is to transfer them all to *Onoba*, which is feasible, but Ponder (1985a), who examined the anatomy of *A. subsoluta*, supported its position in *Alvania*. The anatomy is known only for *Onoba semicostata* and *Alvania subsoluta* (Ponder 1985), of the species involved here and since a thorough generic revision of the rissoids is beyond the scope of this series, we have artificially split the species between *Onoba* and *Alvania*.

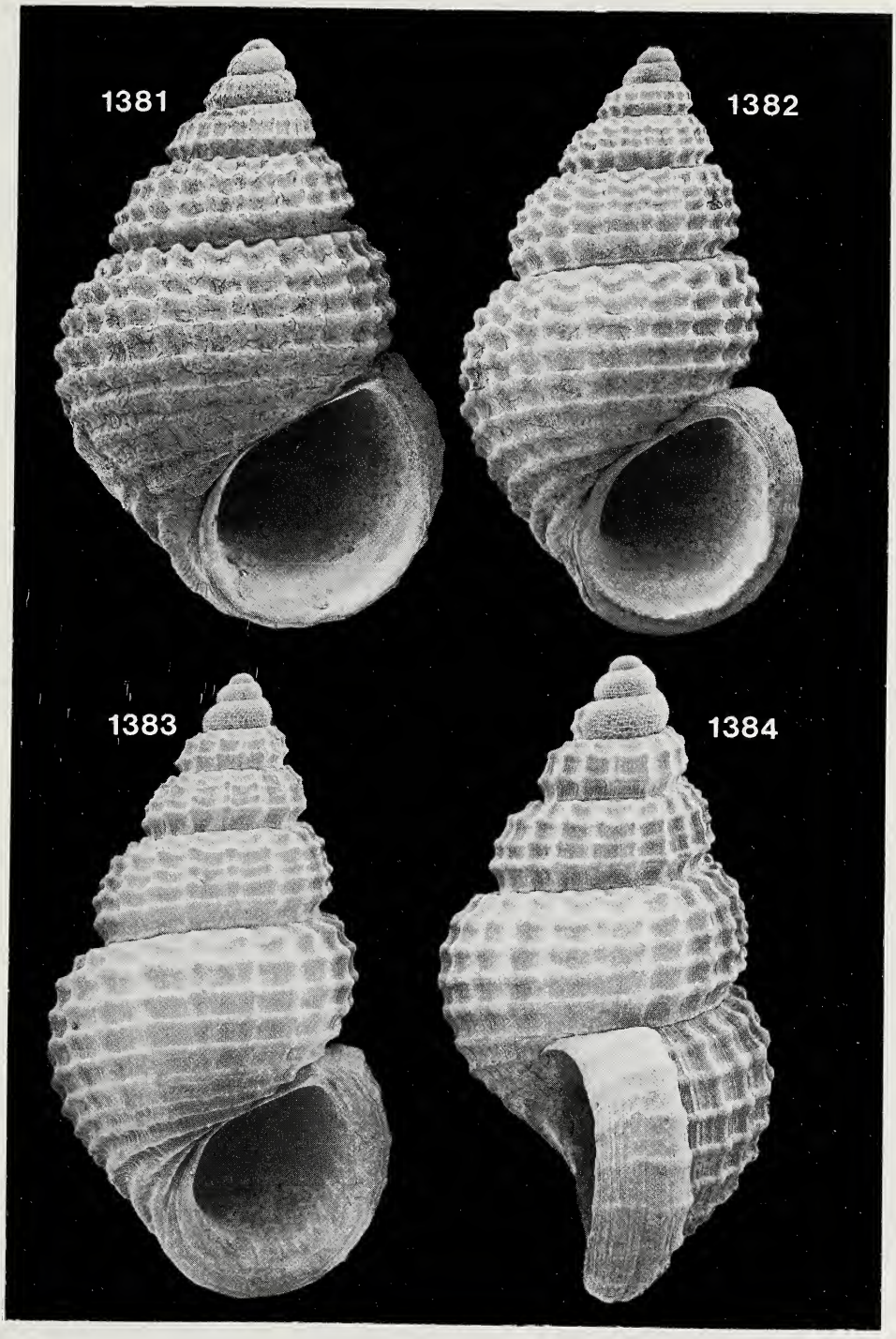
Another such lineage comprises *adinogramma, cancapae, electa,* and *porcupinae*, characterized by a finely granulated protoconch and similar teleoconch features. None of these species is known anatomically.

A third group includes *tarsodes* and *jeffreysi*. For the two latter groups, there are no generic names available.

Finally there is a fourth group, with characters both of *Alvania* and *Crisilla* (which we have used as a genus), for which we have made a new genus, *Gofasia*. This group is additionally characterized by fine spiral lines consisting of microscopic pores.

Alvania cimicoides (Forbes, 1844) Figs 1381-1385

Rissoa cimicoides Forbes, 1844:189.
Rissoa sculpta Philippi, 1844a:131, pl. 23 fig. 21.



Figures 1381-1384. *Alvania cimicoides*. **1381-1382**, Korsfjorden, Norway, 170-130 m, 3.4 and 5.3 mm. **1383-1384**, Rech Lacaze, off Banyuls, southern France, 254-270 m, 2.7 and 2.9 mm.

Rissoa intermedia Aradas, 1847:75 (not Grateloup, 1828).
Rissoa cimicoides var. *minima* Jeffreys, 1867:15.
Turbona hispidula fuscoapicalis Nordsieck, 1974a:11, fig. 6.

Type materials: R. cimicoides, not known; *R. sculpta*, not in ZMHU; *R. intermedia*, 1 syntype, USNM 183974, ex Aradas; *T. hispidula fuscoapicalis*, holotype in coll. Giannini, not seen.

Type localities: R. cimicoides, not designated, Greece; *R. sculpta*, Plio-Pleistocene fossil, Appulia and Gravina, southern Italy; *R. intermedia*, Plio-Pleistocene of Gravitelli, Sicily; *R. cimicoides* var. *minima*, southern Great Britain, Plymouth; *Turbona hispidula fuscoapicalis*, between Corsica and Sardinia, 200-220 m.

Material examined: 300 lots with 4000 shells and specimens, from all parts of the distribution area.

Distribution: From the Denmark Strait between Iceland and Greenland, northern Iceland, and off North Cape, northern Norway, the Azores, to the Canaries, and throughout the Mediterranean, usually in 100-1000 m. It has occasionally been found alive as shallow as 36 m in Scandinavia. Empty, but fresh shells have been taken in 4700 m in the Bay of Biscay, but there are no records between 2007 m and 4700 m.

Remarks: Alvania cimicoides may be recognized by its solid, strongly sculptured shell (which actually gives an impression of a shallow-water species) and the brownish, multispiral protoconch (Fig. 1385) which clearly indicates planktotrophic development (Bouchet 1977).

Alvania cimicoides has almost always been correctly identified, but it is not crystal clear that this is the correct name. *Rissoa sculpta* was published the same year and was better described and figured. Furthermore, Forbes & Hanley (1850:88), used the name *R. sculpta* for *A. cimicoides*. Nevertheless, we can see no reason for a change. This decision is supported by Jeffreys' statement (1867:15) that he had seen Forbes' specimens in BMNH and used the name as it is used here.

Alvania cimicoides is the type species of *Acinulus* L. Seguenza, 1903.

Alvania platycephala Dautzenberg & Fischer, 1896 Figs 1392-1395, 1398

Alvania platycephala Dautzenberg & Fischer, 1896:457, pl. 19 figs 12-13.
Rissoa (Alvania) platycephala and var. *exasperata* Dautzenberg 1927:132, pl. 3 figs 10-11.

Type material: 3 syntypes in MOM, 3 in MNHN.

Type locality: The Azores, MONACO Exp st 553, 37°43' N, 25°05' W, 1385 m.

Material examined: The types and --BARTLETT st 2, 37°14' N, 28°45' W, 480 m, 31 shs (ZMC); MONACO Exp st 112, 38°39' N, 28°06' W, 1287 m, 1 sh (MOM); st 1349, 38°36' N, 28°06' W, 1250 m, 5 shs (MOM).

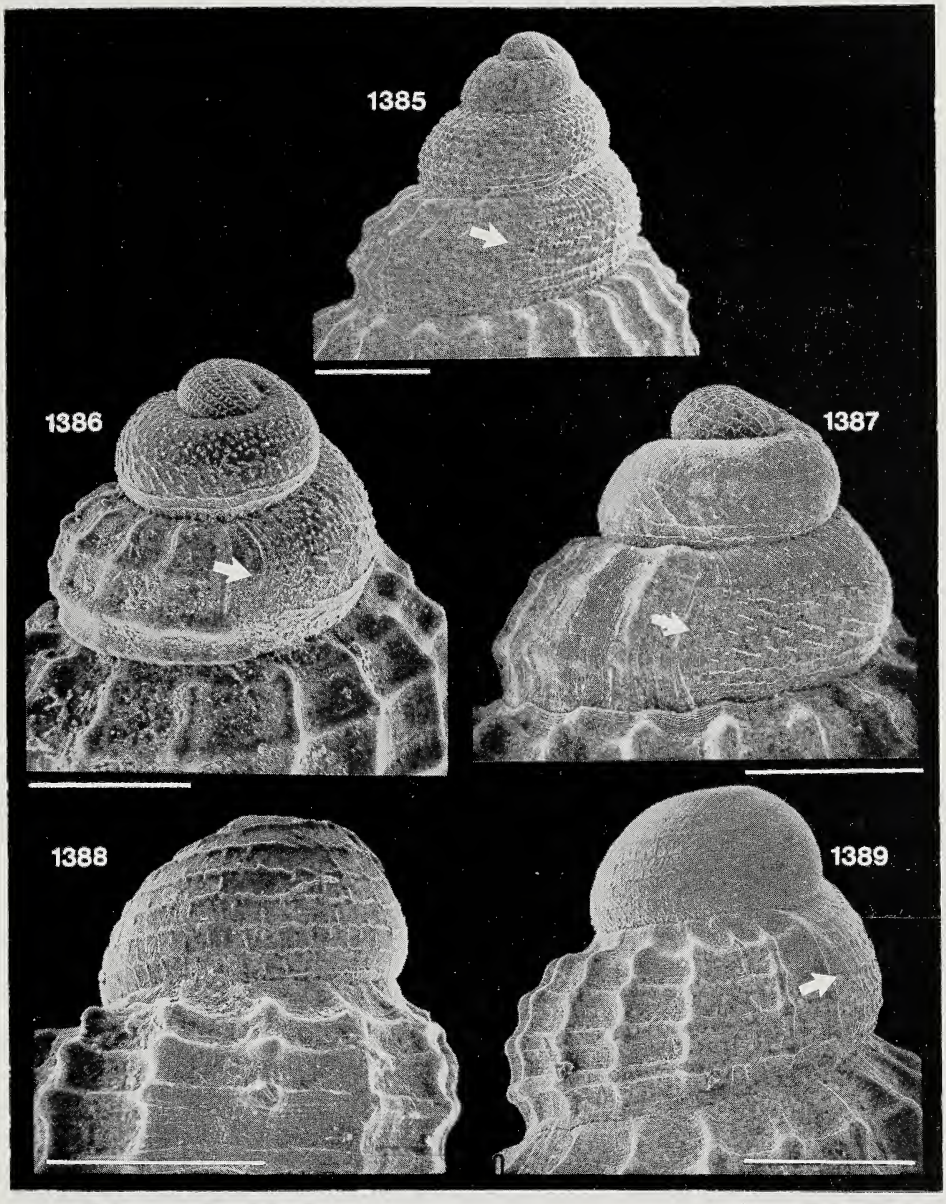
Distribution: Only known from the central part of the Azores in 480-1287 m.

Remarks: Dautzenberg (1927) added 2 localities, ca 1300 m, and named a more coarsely sculptured specimen var. *exasperata* (fig. 11). One very fresh shell from st 112 (determined *zetlandica* by Dautzenberg, but identification never published) indicates that *A. platycephala* may be a deep-water species. The heavy sculpture on both proto- and teleoconch is, however, more characteristic for species from shallow water and we assume this to be a species from intermediate depths. It was not found by Gofas (1990).

Alvania platycephala has several times been recorded from Bermuda, but these records were

shown to be based on a different species (*Alvania bermudensis* Moolenbeek & Faber, 1987).

Alvania sleursi (Amati, 1987) (from the Azores) and *Alvania bermudensis* Faber & Moolenbeek, 1987 are quite similar to *A. platycephala*, but have a coarser sculpture with only two ribs above the suture, and a stouter, more solid, general shape.



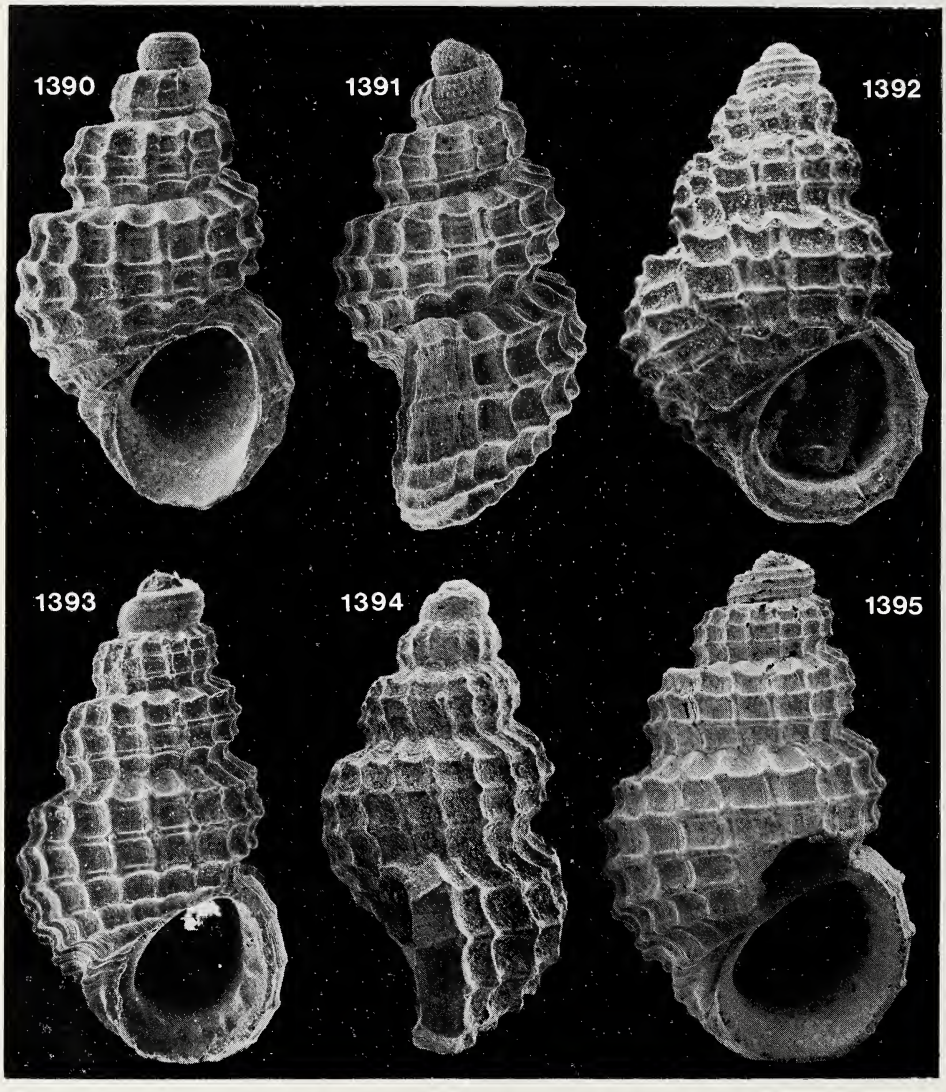
Figures 1385-1389. Protoconchs of *Alvania*. **1385**, *A. cimicoides*, THALASSA st Z435. **1386**, *A. testae*, SE Bay of Biscay, 350 m. **1387**, *A. testae*, western Norway. **1388**, *A. tomentosa*, Strait of Gibraltar, 100-150 m. **1389**, *A. tomentosa*, BALGIM st DW57.

The arrows indicate the protoconch - teleoconch demarcation.

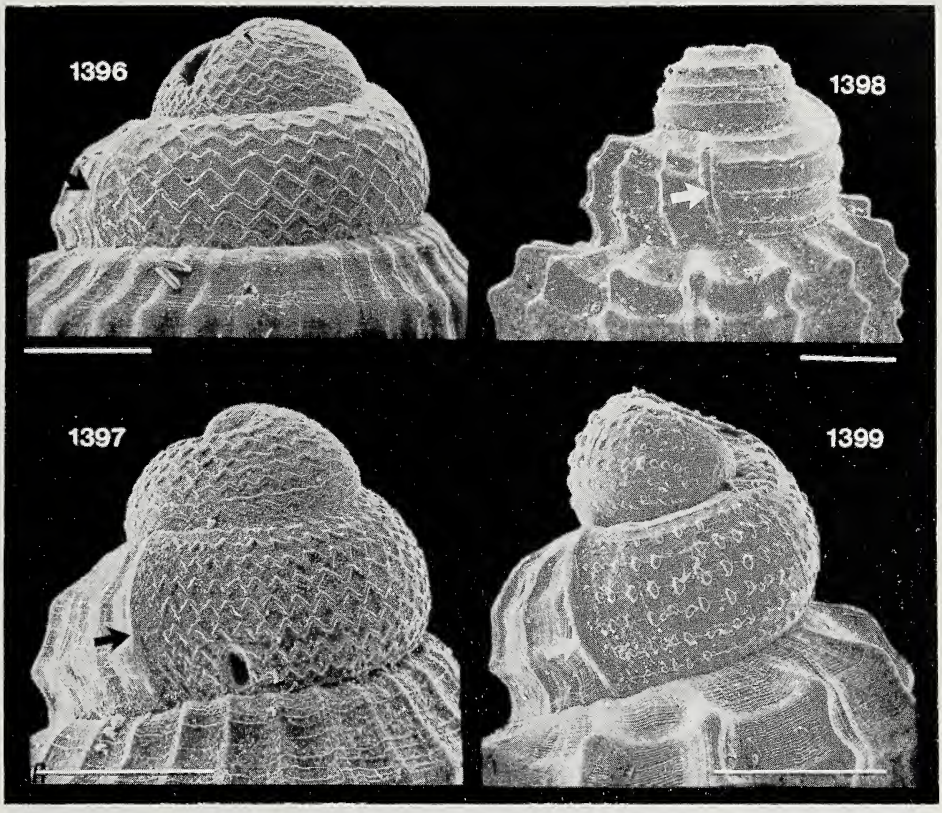
All scale lines 200 μm.

Alvania testae (Aradas & Maggiore, 1844) Figs 1386-1387, 1400-1405

Rissoa testae Aradas & Maggiore, 1844:135. (Date of publication *fide* van Aartsen & Giannuzzi Savelli (1987)).
Rissoa abyssicola var. *conformis* Jeffreys, 1870:77.
Rissoa testae: Jeffreys 1884:115, pl. 9 fig. 4.
Alvania testae: Oliverio *et al.* (in press).



Figures 1390-1395. Genus *Alvania*. **1390**, *A. fischeri*, Tangier Bay, 63 m, 2.28 mm (USNM 182906). **1391**, *A. fischeri*, South of Portugal, 586 m, 2.28 mm. **1392**, *A. platycephala*, BARTLETT st 2, 2.7 mm. **1393**, *A. platycephala*, syntype, 2.3 mm. **1394**, *A. platycephala*, BARTLETT st 2, 3.2 mm. **1395**, *A. platycephala*, syntype, 2.4 mm.



Figures 1396-1399. Genus *Alvania*: protoconchs. **1396**, *A. jeffreysi*, THALASSA st Z434. **1397**, *A. jeffreysi*, off Korsfjorden, western Norway, 275 m. **1398**, *A. platycephala*, BARTLETT st 2. **1399**, *A. fischeri*, off southern Portugal, 586 m.
All scale lines 200 μm.
The arrows indicate the protoconch - teleoconch demarcation.

Type materials: R. testae, 3 possible syntypes USNM 183325, labelled "Gravitelli, Aradas"; *R. conformis*, lectotype (selected by Warén 1980:22, pl. 4 figs 2-3) USNM 183679 and 57 paralectotypes USNM 766596, USNM 182863, and USNM 182680.

Type localities: R. testae, Plio-Pleistocene fossil, Palermo; *R. abyssicola* var. *conformis*, PORCUPINE Exp 1870, Tunis Bay, 54 m.

Material examined: 132 lots with 3300 shells and specimens from all parts of the distributional area.

Distribution: From the Trondheimsfjord, western Norway, to off western Morocco (off Agadir), and throughout the Mediterranean, in 100-800 m, more rarely in 36 m (northern localities) to 2400 m. It is not known from the Faroes or Iceland.

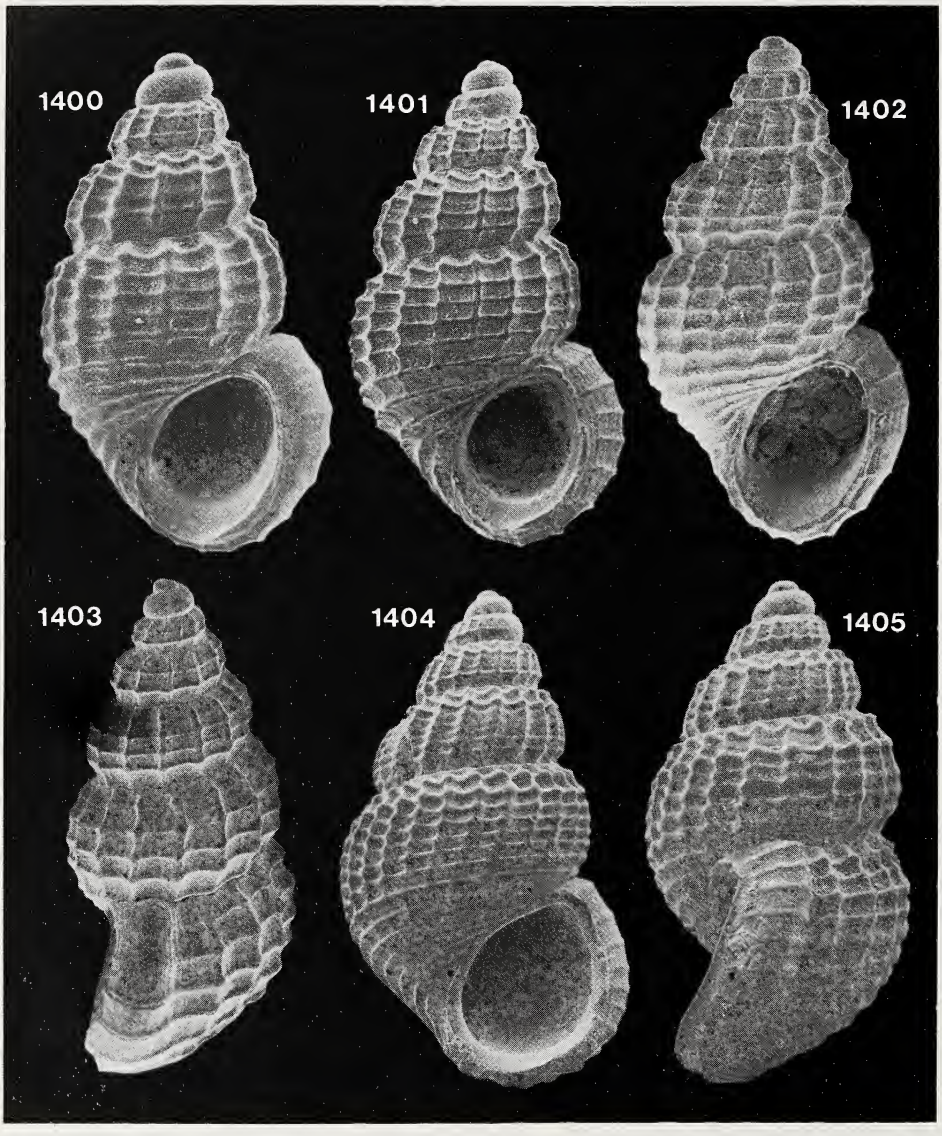
Remarks: The original description of *Rissoa testae* is not easy to interpret, the only useful statement being that it has five to six whorls, but the specimens from Aradas in the Jeffreys collection (USNM) and a rather uniform usage of the name by later authors give this name a good stability.
Jeffreys (before 1870) and Sars (1878) did not distinguish between *A. subsoluta* and *A. testae* and

used Forbes' name *abyssicola* for both. This mistake has been perpetuated in Scandinavian literature.

The easiest way to distinguish the two is the larval shell, which in *testae* (Figs 1386-7) consists of almost two, strongly sculptured whorls, which indicate planktotrophic development, while *A. subsoluta* (Figs 1458-9) has about 1.5 almost smooth whorls with a few hardly visible spiral lines.

Alvania testae inhabits the outer part of the continental shelf, slightly more shallow than *A. subsoluta*, but often living together with it.

Alvania testae is the type species of *Actonia* Monterosato, 1884, by subsequent designation (Crosse 1885).



Figures 1400-1405. *Alvania testae*. **1400**, Bay of Biscay, 1.95 mm (USNM 183312). **1401**, Palermo, 2.5 mm (USNM 332292 ex Monterosato). **1402-1403**, Mediterranean, 110 m, both 2.7 mm (USNM 183695, leg. Nares). **1404-1405**, Norway, Finmark, 2.8 and 2.5 mm (USNM 183653).

Alvania tomentosa (Pallary, 1920) Figs 1388-1389, 1406-1408

Rissoa (Alvania) tomentosa Monterosato MS, Pallary, 1902:18 (*nom. nud.*)
Rissoa (Alvania) tomentosa Monterosato MS, Pallary 1920:50, fig. 27.
Alvania altenai van Aartsen, Menkhorst & Gittenberger, 1984:23, fig. 99.

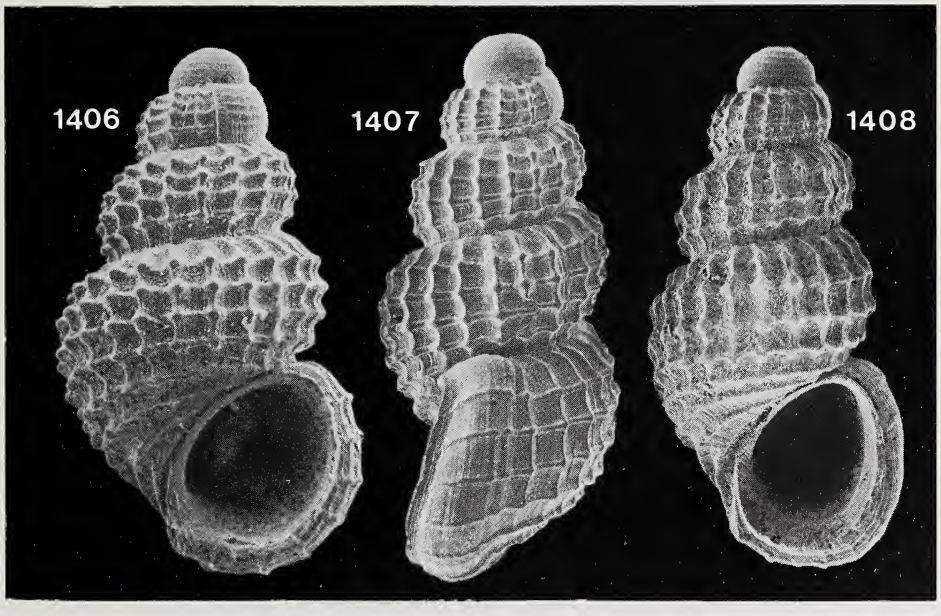
Type materials: R. tomentosa, not known; *A. altenai*, holotype RMNH 55666, paratypes in the collections of van Aartsen, Menkhorst and Bogi (not seen).

Type localities: R. tomentosa, Tangiers, Morocco; *A. altenai*, 4 km south of Algeciras, southern Spain.

Material examined: --West of Cape Finisterre, NW Spain, 900 m, 1 sh (SMNH); --Strait of Gibraltar, 100-150 m, 1 sh (MNHN, leg. Gofas); BALGIM st DR37, 36°18' N, 07°15' W, 864 m, 2 shs; st DR40, 35°50' N, 06°09' W, 362 m, 1 sh; st DW50, 35°53' N, 06°32' W, 522 m, 3 shs; st DW57, 35°42' N, 06°35' W, 548 m, 1 sh; st DW132, 35°26' N, 04°19' W, 170 m, 2 shs; PORCUPINE Exp 1870, st 24, 37°19' N, 09°13' W, 531 m, 9 shs (coll. Sykes, BMNH); st 30, 36°15' N, 06°52' W, 702 m, 21 shs (coll. Sykes, BMNH); st Cadiz, 557 m, 1 sh (Museo di Zoologia, Roma); st Adventure Bank, 167 m, 1 sh (Museo di Zoologia, Roma).

Distribution: From off northwestern Spain to the Ibero-Moroccan Gulf and the northern Tyrrhenian Sea (van Aartsen *et al.* 1984), in 120-900 m.

Remarks: The name *Rissoa tomentosa* was originally suggested by Jeffreys when he sent to Monterosato some specimens dredged by the PORCUPINE Exp in 1870, on Adventure Bank and off Cadiz. We have examined those specimens in Museo di Zoologia, Roma, as well as the PORCUPINE



Figures 1406-1408. *Alvania tomentosa*. **1406**, Strait of Gibraltar, 100-150 m, 1.6 mm. **1407**, BALGIM st DW57, 1.9 mm. **1408**, West of Cap Finisterre, 1.8 mm.

specimens above, which had been identified by Monterosato for Sykes and intended for publication in Sykes (MS) with a reference to Pallary's figure. We consider this figure (1920, fig. 27) good enough for identification. So does S. Gofas, who long ago had identified this species among material collected by him at the type locality.

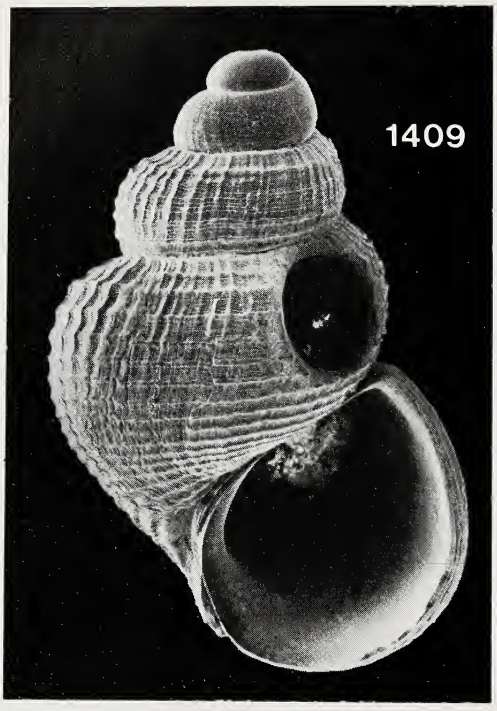


Figure 1409. *Alvania dipacoi*, CANCAP st 2.058, 2.3 mm.

Alvania dipacoi Giusti & Nofroni, 1989 Figs 1409, 1538-1539

Alvania dipacoi Giusti & Nofroni 1989:54, figs 1-5.

Type material: Holotype, Museo Provinciale di Storia Naturale, Livorno, no 333 (not seen).

Type locality: Northwest of Capraia, Tuscan archipelago, Tyrrhenian Sea, 320-440 m.

Material examined: --CANCAP st 2.058, 27°58' N, 13°15' W, 500 m, 8 shs.

Distribution: Only known from the type locality and the record above, from Italy to Mauretania in a few hundred meters depth.

Remarks: The sculpture of the protoconch (Fig. 1538), well figured in the original description, groups *A. dipacoi* in the vicinity of *A. adinogramma* and *A. cancapae*, but those two species (Figs 14305) have a smaller aperture and weaker spiral sculpture, and the general shape is more inflated in *A. dipacoi*. The sculpture of the protoconch of the Atlantic material consists of microgranules only, and lacks the spiral cords present in Mediterranean specimens. We nevertheless believe them to be conspecific.

Alvania wareni (Fig. 1462) differs in having much weaker axial sculpture, with the spiral ribs dominating, and by lacking the granules on the protoconch.

Alvania electa (Monterosato, 1874) Figs 1410-1420

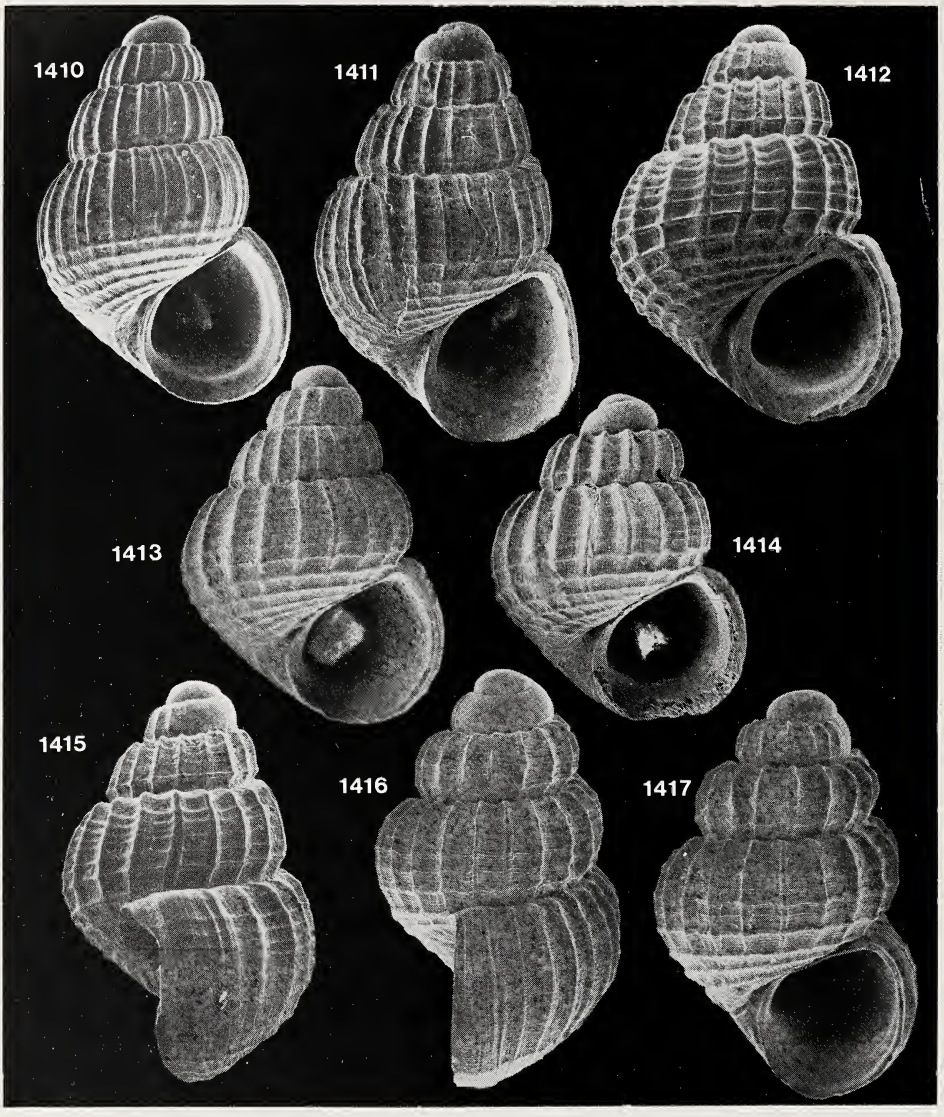
Rissoa abyssicola var. *obtusa* Jeffreys, 1870:77. (Not *Rissoa obtusa* Cantraine, 1842).
Rissoa electa Monterosato, 1874:261.
Rissoa (Alvania) elegantissima Seguenza MS, and var. *major* Monterosato, 1875:27. (Not *R. elegantissima* Seguenza, 1876).
Rissoa deliciosa Jeffreys, 1884:121, pl. 9 fig. 7.
Rissoa (Alvania) deliciosa: Watson 1886:587.
Rissoa abyssicola var. *obtusa:* Warén 1980:22, pl. 4 figs 4-5.

Type materials: R. abyssicola var. *obtusa*, holotype, USNM 183681; *R. electa*, one possible lot in Museo di Zoologia, Roma, labelled "San Vito 100 f"; *R. deliciosa*, lectotype (Warén 1980:22) USNM 183505 and 15 paralectotypes USNM 710974.

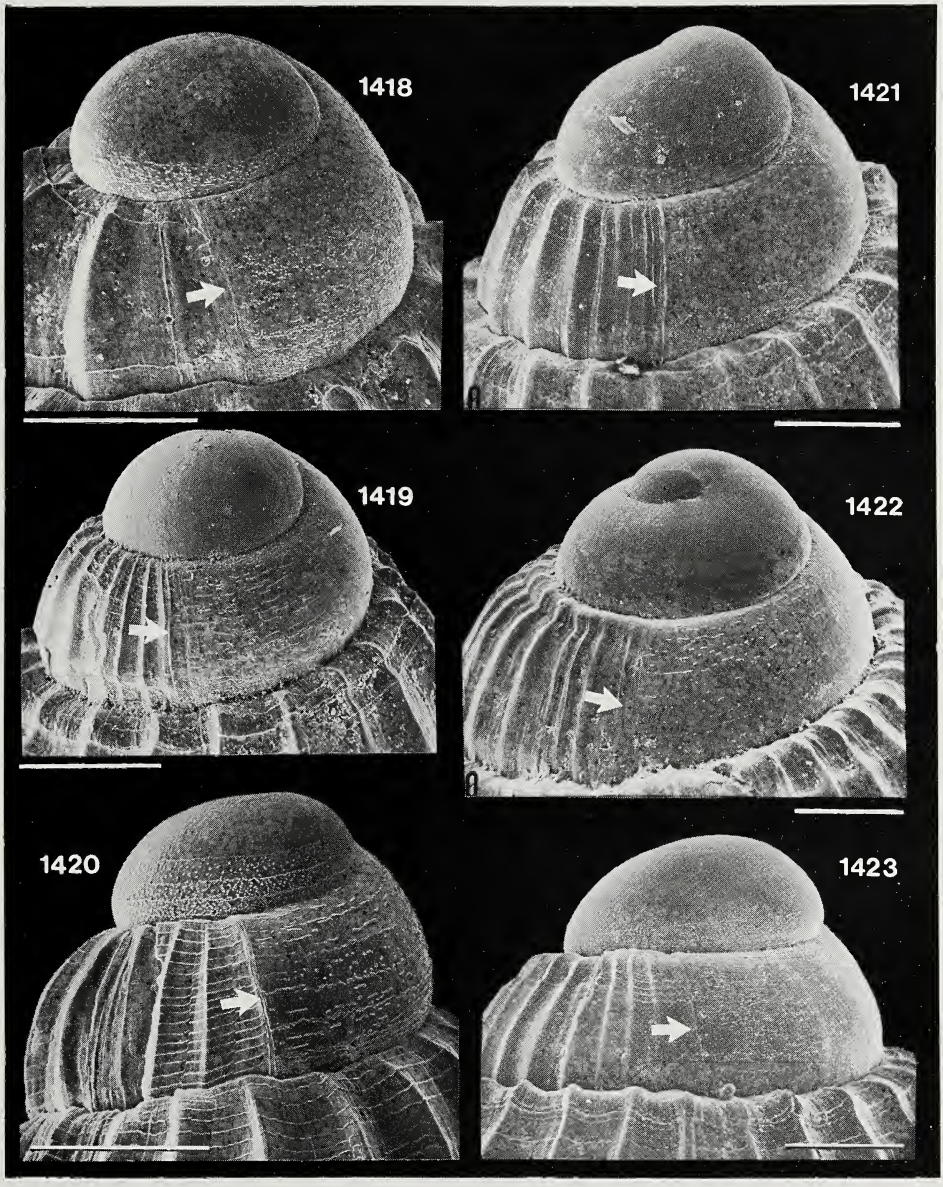
Type localities: R. abyssicola var. *obtusa*, coast of Tunis, 90-180 m; *R. electa*, off Capo San Vito, Sicily; *R. deliciosa*, PORCUPINE Exp 1870, Adventure Bank, 167 m (Warén 1980:22).

Material examined: The types and
--Bay of Biscay:TRAVAILLEUR Exp 1880, dr 2,6,9,7,20,44, 87, north of Spain, 12 spms (MNHN); PORCUPINE Exp 1870 st [south off] English Channel, 1305 m, 1 sh (coll. Sykes, BMNH); THALASSA st X340, 44°07' N, 04°30' W, 885 m, 3 spms; st X341, 44°07' N, 04°31' W, 820 m, 1 sh; st X342, 44°08' N, 04°37' W, 700 m, 1 spm; st X343, 44°07' N, 04°37' W, 630 m, 2 shs; st X347, 44°07' N, 04°44' W, 755 m, 3 shs; st X353, 44°07' N, 04°45' W, 645 m, 2 shs; st X362, 44°07' N, 04°51' W, 590 m, 4 shs; st X363, 44°06' N, 04°54' W, 590 m, 5 spms; LAGARDERE st GCh9, 44°00' N, 02°28' W, 1020-1040 m, 35 spms; st GCh68, 43°58' N, 02°30' W, 1000- 1020 m, 10 spms; st GCh69, 43°57' N, 02°31' W, 995-1015 m, 8 shs; st Gch76, 44°33' N, 02°16' W, 1000-1040 m, 3 shs.
--Southern Europe and northwest Africa: --PORCUPINE Exp 1870, st 15, off Portugal, about 40 N, 2 shs (USNM 183484); st 17, 39°42' N, 09°43' W, 1092-1993 m, 19 shs (coll. Sykes, BMNH); st 20, Portugal, Setubal Bay, 27 shs (USNM 183488); st 24, 37°19' N, 09°13' W, 531 m, 61 shs (USNM 183489), 5 spms (coll. Sykes, BMNH); st 25, 37°11' N, 09°07' W, 680 m, 74 shs (coll. Sykes, BMNH); st 27, 36°37' N, 07°33' W, 586 m, 26 shs (USNM 183491, USNM 183490); st 28a, 36°29' N, 07°16' W, 520 m, 22 shs (USNM 183492); st 29, 36°20' N, 06°47' W, 413 m, 15 shs (USNM 183493); st 30, 36°15' N, 06°52' W, 702 m, 9 shs (USNM 183494), 54 shs (coll. Sykes, BMNH); st 31, 35°56' N, 07°06' W, 868 m, 24 shs (USNM 183495); st 32, 35°41' N, 07°08' W, 1184 m, 12 shs (USNM 183496); st 33, 35°33' N, 06°54' W, 1008 m, 14 shs (USNM 183497); st 34, 35°44' N, 06°53' W, 753 m, 15 shs (USNM 183498); st Cape Sagres, 72-105 m, 12 shs (coll. Sykes, BMNH); --CANCAP st 2.065, 28°11' N, 13°57' W, 670 m, 20 shs; st 2.066, 28°01' N, 13°57' W, 886 m, 7 shs; st 2.067, 27°58' N, 14°12' W, 1820 m, 4 shs; st 2.074, 28°02' N, 14°29' W, 530 m, 19 shs; st 2.080, 28°01' N, 14°26' W, 980 m, 1 sh; st 2.085, 28°02' N, 14°30' W, 600 m, 16 shs; st 3.082, 30°07' N, 15°53' W, 600 m, 11 shs; st 4.060, 28°48' N, 13°45' W, 590 m, 100+ shs; st 4.062, 28°48' N, 13°43' W, 590 m, 50 shs; st 4.064, 28°47' N, 13°41' W, 1030 m, 10 shs; st 4.086, 28°54' N, 13°33' W, 785 m, 43 shs; st 4.101, 29°06' N, 13°26' W, 315 m, 2 shs; BALGIM st DW02, 36°55' N, 09°16' W, 894 m, 1 sh; st CP03, 36°50' N, 09°15' W, 682 m, 1 spm; st DW24, 36°41' N, 07°19' W, 545 m, 3 shs; st DW43, 35°54' N, 06°14' W, 150 m, 2 spms; st DW50, 35°53' N, 06°32' W, 522 m, 1 spm; CINECA st B33, 29°23' N, 10°50' W, 132 m, 12 shs.
--Mediterranean: PORCUPINE Exp 1870 st 50, off Algeria, 9-93 m, 84 shs (USNM 183504); st 56, 37°03' N, 11°36' E, 710 m, 56 shs (USNM 183506), 78 shs (coll. Sykes, BMNH); st Adventure Bank, 54-167 m, 6 shs (paralectotypes, USNM 710974), 93 spms (coll. Sykes, BMNH), 39 shs (SMNH); st off Tunis, 364-1092 m, 14 shs (coll. Sykes, BMNH); --st Tripoli, 72-218 m, 11 shs (coll. Sykes, BMNH); st off Tunis, 91-182 m, 4 shs (coll. Sykes, BMNH); st Tangiers, 65 m, 2 shs (coll.

Sykes, BMNH); SHEARWATER Exp, Adventure and Skerki Banks, 72-330 m, 24 shs (USNM 183503); --TRAVAILLEUR Exp 1881 st ?, Mediterranean, 670 m, 1 sh (USNM 183500); TRAVAILLEUR Exp 1881 st ?, Mediterranean, 1085 m, 2 shs (USNM 183501); dr 1, 43°03' N, 05°19' E, 555 m, 1 sh (USNM 183482); dr 5, 42°54' N, 05°21' E, 1865 m, 2 shs (MNHN; these specimens had been examined by Jeffreys, and returned); --Mediterranean, 270-900 m, 52 shs (USNM 183502, ex Nares); off Tunis, 200-220 m, 2 shs (Palazzi leg., SMNH); BIOMEDE 1, st 1, 42°59' N,



Figures 1410-1417. *Alvania electa*. **1410**, CANCAP st 4.060, 2.9 mm. **1411**, BALGIM st CP95, 1.9 mm. **1412**, PORCUPINE Exp 1870 st 56, 2.00 mm (USNM 183506). **1413**, PORCUPINE Exp st ?, 2.0 mm (USNM). **1414**, Casablanca, 600 m, 2.2 mm. **1415**, PORCUPINE Exp 1870 st 56, 2.1 mm (USNM 183506). **1416-1417**, THALASSA st X362, 1.8 and 1.7 mm.



Figures 1418-1423. Genus *Alvania*: protoconchs. **1418,** *A. electa*, CANCAP st 4.062. **1419,** *A. electa*, BALGIM st CP95. **1420,** *A. electa*, 44°00' N, 02°28' W, 1020-1040 m. **1421,** *A. porcupinae*, CANCAP st 2.062. **1422,** *A. porcupinae*, CINECA st B31. **1423**, *A. porcupinae*, CHALLENGER st 85 (USNM 183499).

All scale lines 200 μm.

The arrows indicate the protoconch - teleoconch demarcation.

06°00' E, 1125 m, 13 shs; st 2, 42°40' N, 06°00' E, 2770-2420 m, 1 sh; st 15, 42°53' N, 06°10' E, 1500-1600 m, 1 sh; BALGIM st DW120, 35°51' N, 05°10' W, 425 m, 33 shs; st DW121, 35°56' N, 05°02' W, 569 m, 1 sh.

Distribution: From the southern part of the Bay of Biscay, south to the Canaries, also in the Mediterranean, normally in 150-800 m, occasionally 80-2800 m (in the Mediterranean).

Remarks: Alvania electa is rather variable. Mediterranean specimens from shallow water (100-300 m, Figs 1412-5) and specimens from off northwestern Africa (Fig. 1410) have the well known appearance with sharp, axial ribs which end abruptly at the suture (and made Monterosato (1874) compare his new species with *Hinia limata*). Specimens from the west coast of the Iberian Peninsula and the Bay of Biscay (Figs 1416-7) have more rounded ribs which gradually become lower towards the suture. To this category belong also the specimens from BIOMEDE 1, which were found unusually deep for the Mediterranean.

It is possible that two species are involved, as Oliverio *et al.* (in press) suggest, but we have had problems to keep the forms separate, when working on Atlantic specimens.

Monterosato said "Elle sera décrite et figurée ultérieurement" but we nevertheless find his comparison with *Hinia limata* good enough to qualify as a description. This will also promote stability in the nomenclature, since the name *electa* is the oldest name and its usage has been recently advocated by several Italian authors (e.g. Oliverio *et al.* 1986).

Van Aartsen & Fehr-de Wal (1973) redescribed and figured what they considered to be *Alvania deliciosa* from the Ria de Arosa area, northern Spain, 78 m. The SEM photos, however, show that this record is based on *A. zylensis* Gofas & Warén, 1982, a shallow-water species.

Alvania porcupinae (Figs 1424-9) differs from *A. electa* in being about 50% larger, in having more numerous axial ribs (35-45 instead of 20-30) and in having a larger, more dome-shaped protoconch (Figs 1421-3) with about 1.75 whorls instead of 1.2 whorls as in *electa* (Figs 1418-21).

Alvania porcupinae Gofas & Warén, 1982 Figs 1378-1379, 1421-1429

Rissoa (Alvania) deliciosa var. *multicostata* Jeffreys, 1884:121. (Not *Rissoa multicostata* C.B. Adams, 1850).
Rissoa deliciosa var. *multicostata:* Warén 1980:22, pl. 4 figs 6-7.
Alvania porcupinae Gofas & Warén, 1982:6, figs 23, 30, 31 (*nom. nov.* for *Rissoa deliciosa* var. *multicostata* Jeffreys, 1884).

Type material: Lectotype (selected by Warén 1980:22) USNM 183487 and 7 paralectotypes, USNM 710973.

Type locality: PORCUPINE Exp 1870 st 17a, off Portugal, 39°39' N, 09°39' W, 1346 m (Warén 1980:22).

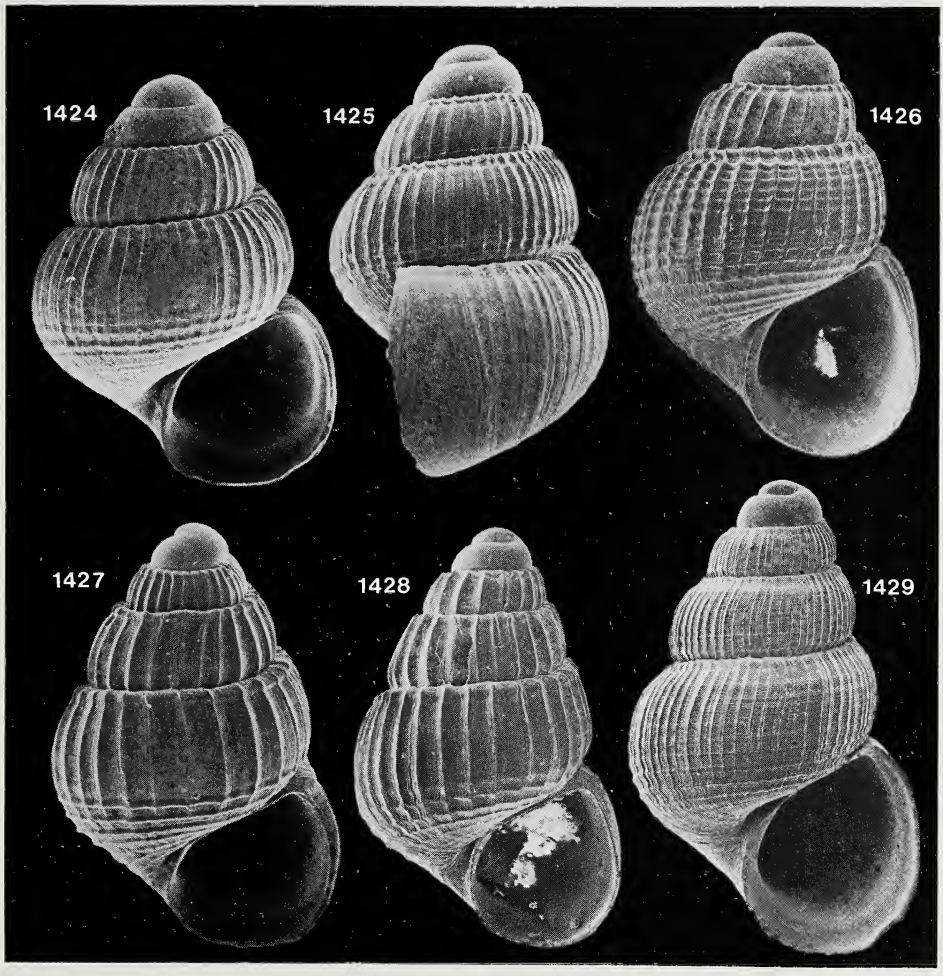
Material examined: The types and:

--Bay of Biscay: THALASSA st X339, 44°10' N, 04°30' W, 1560 m, 1 sh; st X340, 44°07' N, 04°30' W, 885 m, 1 sh; --st Z400, 47°33' N, 07°19' W, 1175 m, 1 sh; st Z417, 48°12' N, 09°10' W, 865 m, 2 shs; st Z457, 48°38' N, 09°53' W, 800 m, 2 shs; BIOGAS st CP07, 44°10' N, 04°16' W, 2170 m, 1 spm; st CP23, 44°04' N, 04°21' W, 1980 m, 5 spms; st CP24, 44°08' N, 04°16' W, 1995 m, 6 spms; st CP35, 46°34' N, 10°23' W, 4720 m, 2 shs; st DS52, 44°06' N, 04°22' W, 2006 m, 19 spms; st DS53, 44°30' N, 04°56' W, 4425 m, 4 spms; SARSIA st 7614, 43°43' N, 03°38' W, 1100 m, 5 shs; LAGARDERE st Chg 9, 44°00' N, 02°28' W, 1020-1040 m, 2 spms; st GCh68, 43°58' N, 02°30' W, 1000-1020 m, 2 shs; --TRAVAILLEUR Exp, 2 shs (USNM 183508, ex de Folin).

--Southwestern Europe and Northwest Africa: THALASSA st Y393, 41°21' N, 09°11' W, 820 m, 1 sh; st Y401, 40°37' N, 09°21' W, 1040 m, 1 sh; st Y405, 40°33' N, 09°27' W, 1170 m, 3 shs; st Y428,

44°12' N, 08°41' W, 500 m, 5 shs; --SEAMOUNT st CP30, 36°44' N, 11°23' W, 1940-2075 m, 1 spm, 40 shs; st DW108, 42°51' N, 11°53' W, 1110-1125 m, 1 sh; st DW116, 42°52' N, 11°51' W, 985-1000 m, 1 sh; --CINECA st B31, 29°35' N, 11°03' W, 1500 m, 6 shs; --CANCAP st 2.062, 28°07' N, 13°45' W, 1520 m, 3 shs; st 2.067, 27°58' N, 14°12' W, 1820 m, 2 shs; st 4.055, 28°45' N, 13°20' W, 1209-1338 m, 3 shs; MONACO Exp st 2048, 32°33' N, 17°02' W, 1968 m, 12 shs; PORCUPINE Exp 1870 st 16, 39°55' N, 09°56' W, 1809 m, 18 shs (USNM 183485); st 17, 39°42' N, 09°43' W, 1092-1993 m, 1 sh (USNM 183486), 41 shs (coll. Sykes, BMNH); CHALLENGER Exp st 85, 28°42' N, 18°06' W, 1820 m, 2 shs (USNM 183499); BALGIM st DW11, 36°44' N, 09°31' W, 1520 m, 1 spm; st CP68, 35°12' N, 07°53' W, 1998-2077 m, 1 sh; st CP95, 34°24' N, 07°39' W, 1378 m, 3 spms.

Distribution: From the northernmost part of the Bay of Biscay, south to the Canaries, in 800-4700 m. Not found in the Mediterranean.



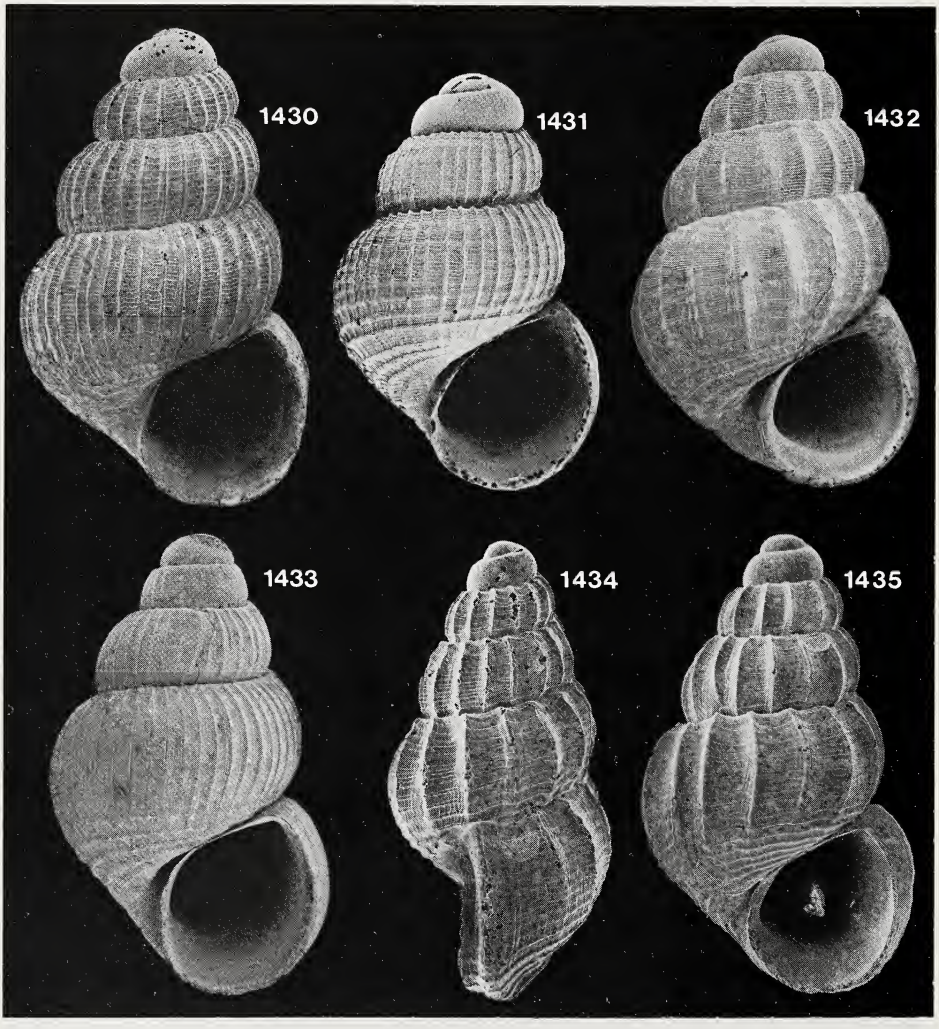
Figures 1424-1429. *Alvania porcupinae*. **1424-1425**, BIOGAS st DS53, 2.4 mm. **1426**, CINECA st B31, 2.3 mm. **1427**, CHALLENGER st 85, 2.7 mm (USNM 183499). **1428**, CANCAP st 2.062, 2.5 mm. **1429**, SEAMOUNT st CP30, 2.5 mm.

Remarks: Alvania porcupinae is one of the very few rissoids restricted to the deep-sea in European waters. Almost all other species which occur on the continental slope also inhabit the outermost part of the shelf.

The specimen in Fig. 1429 most likely belongs to this species. It differs in shape and sculpture, but the large sample from SEAMOUNT st CP30 exhibits a good deal of variation and the specimen is one of the most deviating ones.

We figure (Figs 1378-1379) an egg-capsule and a specimen ready to hatch from the same egg-capsule. The development is obviously lecithotrophic.

For differences from *A. electa*, see that species.



Figures 1430-1435. Genus *Alvania*. **1430**, *A. adinogramma*, SEAMOUNT st DW45, 1.6 mm. **1431,** *A. adinogramma*, PORCUPINE Exp 1870 st 24, 1.5 mm (USNM 183275). **1432,** *A. adinogramma*, SEAMOUNT st CP12, 1.8 mm. **1433,** *A. cancapae*, MONACO Exp st 2048, 2.2 mm. **1434-1435,** *A. cancapae*, CANCAP st 2.074, both 2.5 mm.

Alvania adinogramma sp.n. Figs 1430-1432, 1449

Type material: Holotype (not figured) and 14 paratypes in MNHN and SMNH 4353.

Type locality: SEAMOUNT st DW16, 36°33' N, 11°33' W, 255-265 m (Gorringe Bank, off Portugal).

Material examined: The types and SEAMOUNT st DW08, 36°29' N, 11°37' W, 470-485 m, 4 shs; st DE10, 36°27' N, 11°35' W, 500-545 m, 1 sh; st CP12, 36°24' N, 11°43' W, 1005-1040 m, 1 sh; st DW15, 36°33' N, 11°29' W, 300-330 m, 2 shs; st CP20, 36°34' N, 11°30' W, 305-320 m, 6 shs; st DW21, 36°35' N, 11°28' W, 460-480 m, 1 sh; st DW45, 36°46' N, 17°05' W, 315-335 m, 2 shs; PORCUPINE Exp 1870, st 24, 37°19' N, 09°13' W, 531 m, 2 shs (USNM 183272); st 26, 36°44' N, 08°08' W, 662 m, 2 shs (USNM 183273).

Distribution: Off southern and southwestern Portugal, also Gorringe and Josephine seamounts, in 300-1000 m.

Description: Shell (Figs 1430-2) small, vitreous but solid, of an ovate to cylindrical shape and with a blunt apex. Larval shell (Fig. 1449) consisting of 1.25 whorls, with an extremely fine sculpture of irregularly arranged, short spiral lines and microtubercles. Diameter 340 μm. The holotype has 3.25 teleoconch whorls of slowly increasing diameter. The axial sculpture consists of sharp, narrow, evenly curved ribs, reaching from suture to suture and at the upper suture forming a low spine-like process by being distinctly angulated. There are up to 35 such ribs on the body-whorl. They disappear gradually below the periphery of the body-whorl and also become lower and finally disappear behind the outer lip. The spiral sculpture consists of 7-9 stronger spiral ribs on the basal surface and up to the lower 1/3-1/5 of the whorls and numerous, very fine and sharp microstriae, visible under a stereo-microscope and of regularly alternating strength. These micro-striae cover the whole surface, but are less conspicuous on the basal surface. The aperture is small and evenly rounded, with a slightly thickened outer lip. There is a small umbilical crevice behind the inner lip.
Dimensions. Height of holotype 1.64 mm, diameter 0.91 mm.

Etymology: Adinos (Greek) dense, crowded and *gramme* (Greek) line.

Remarks: For differences from *A. cancapae*, see under that species. The specimens from the PORCUPINE Exp had been identified as *A. subsoluta*, which *A. adinogramma* resembles in shape (Figs 1453-7), but *adinogramma* is smaller and has a more regular, finer and yet more conspicuous spiral striation.

In more shallow water on the seamounts off southwestern Portugal, there occurs an undescribed species, evidently closely related to *A. adinogramma*, but with a wide umbilicus, broader shape and strong spiral lines on the larval shell.

Alvania cancapae sp.n. Figs 1433-1435, 1451

Type material: Holotype in RMNH, 17 paratypes, RMNH, MNHN and SMNH 4354.

Type locality: CANCAP st 2.085, 28°02' N, 14°30' W, 600 m (Canaries).

Material examined: The types and --CANCAP st 2.065, 28°11' N, 13°57' W, 670 m, 1 sh; st 2.074, 28°02' N, 14°29' W, 530 m, 14 shs; st 2.157, 27°35' N, 17°59' W, 650 m, 1 sh; MONACO Exp st 2048, 32°33' N, 17°02' W, 1968 m, 2 shs (MOM), 1 sh (MNHN).

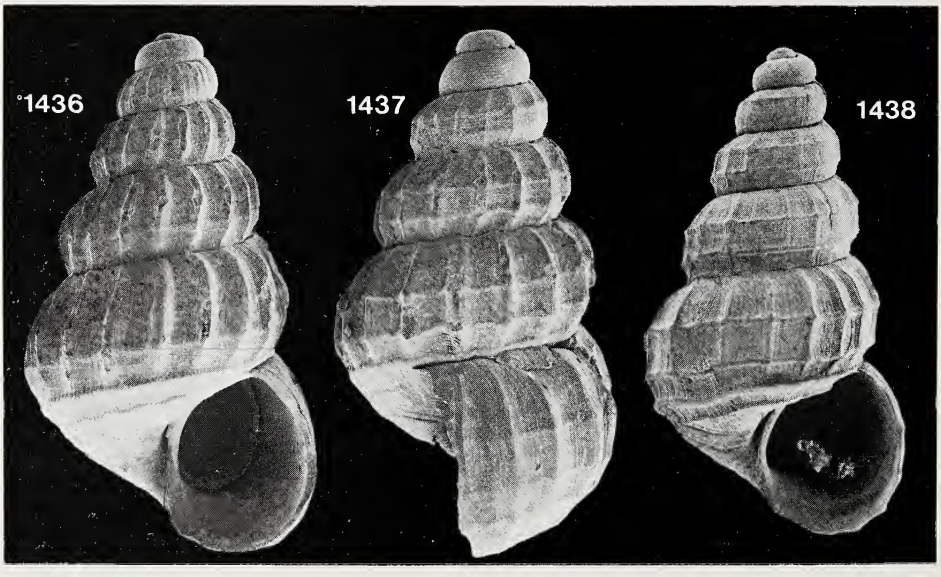
Distribution: Off southern Morocco, in 500-2000 m.

Description: Shell (Figs 1433-5) small, fairly solid, transparent, conically ovate with strong axial ribs and blunt apex. Larval shell (Fig. 1451) of 1.2 rather convex whorls, sculptured with numerous very small tubercles, to some extent arranged in short, interrupted lines. Diameter 400-440 μm. Teleoconch with 3.1-3.4 evenly convex whorls of slowly increasing diameter, sculptured with numerous strong, slightly curved axial ribs which reach from suture to suture, but vanish below the level of the suture on the body-whorl. The number varies between 16 and 32 on the body-whorl, and there is a tendency that they become weaker some distance behind the labial varix. The spiral sculpture consists of 5-10 stronger ribs, confined to the basal area and lower 1/3 of the whorls and a microstriation of regularly varying strength. Aperture evenly rounded with a well developed parietal callus and an inner lip reflected over the conspicuous umbilical crevice. Outer lip thickened by a labial varix.
Dimensions. Height of holotype 2.18 mm, breadth 1.30 mm, maximum height 2.5 mm.

Etymology: Named after the CANCAP deep-sea program carried out by RMNH off northwestern Africa.

Remarks: Alvania cancapae is a very variable species regarding the size and sculpture. Our scanty material gives an impression that shallow water specimens have a stronger sculpture and have a more solid shell, a common tendency among gastropods.

Alvania cancapae resembles *A. adinogramma* (Figs 1430-2) in the arrangement of the sculpture, but the teleoconch is more cylindrical and smaller (1.6-1.8 mm) in *adinogramma*, and the apertural rim is more developed in *A. cancapae*.



Figures 1436-1438. *Alvania pseudoareolata*. **1436-1437**, Trinity Bay, Newfoundland, 3.1 mm (SMNH). **1438**, off NW Iceland, 3.1 mm (SMNH).

Alvania pseudoareolata Warén, 1974 Figs 1436-1438, 1490, 1492

Cingula areolata: Verrill 1879:311; Verrill 1882:524, pl. 43 fig. 2. (not *Turritella areolata* Stimpson, 1851).
Alvania pseudoareolata Warén, 1974:130, figs 35-38.
Pusillina (Ameririssoa) pseudoareolata: Ponder 1985a:30, (figs 17, 83E?, F?), 84A-G.

Type material: Holotype, USNM 153637 and 5 paratypes, USNM 184952.

Type locality: USFC st 135, 42°43' N, 70°39' W, 40 m.

Material examined: See Warén 1974, and --off southeastern Greenland, 64°39' N, 34°57' W, 900 m, 1 sh; northern Iceland, Skjalfandi, ca 100 m, 2 shs.

Distribution: Maine to Newfoundland, southeastern Greenland, northern and western Iceland, in 40-900 m (Warén 1974, Rex *et al.* 1988).

Remarks: Alvania pseudoareolata is the type species of *Ameririssoa* Ponder, 1985, a subgenus of *Pusillina*. Ponder's figure of the specimen he examined the anatomy of (1985a, fig. 83E, F) differs considerably from our concept of the species and from the type lot (Ponder 1985, fig. 84) of *A. pseudoareolata*. We are therefore not yet prepared to transfer the species to *Pusillina*.

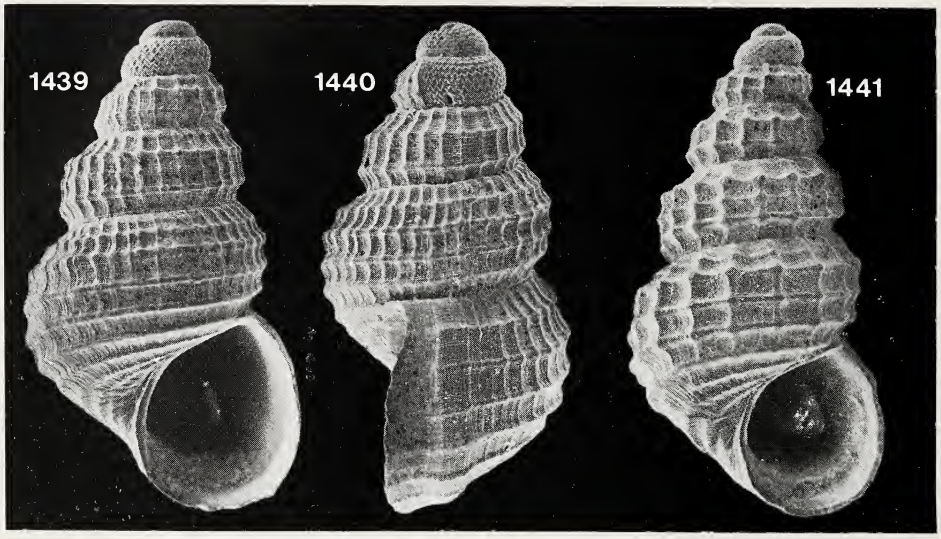
Alvania jeffreysi (Waller, 1864)
Figs 1375-1376, 1396-1397, 1439-1441

Rissoa jeffreysi Waller, 1864:136.

Type material: 2 possible syntypes, Unst, Shetland, 1863, USNM 182291.

Type locality: Off Unst, Shetland, 146-155 m.

Material examined: The types and The Skagerrak and Norway north to Hammerfest, Vardö and Vadsö, 134 lots with 5200 spms (SMNH, ZMO, ZMB, ZMC, USNM); western Iceland, INGOLF st 98, 65°38' N, 26°27' W, 251 m, fragments (ZMC); southwestern Iceland, Faxafloi and Vikurall, 100-300 m, numerous specimens (private collections); off southeastern Greenland, 65°51' N, 35°07' W, 264 m, 1 sh (coll. Jón Bogason); east of the Faroes, 60°54' N, 03°42' W, 2 spms (ZMC); Faroes, 61°40' N, 07°40' W, 250 m, a few shs (ZMC); --The material from the NORWEGIAN NORTH ATLANTIC Exp (listed by Warén 1973:6); BIOFAR st 019, 62°12.0' N, 04°25.0' W, 276 m, 3 shs; st 056, 61°54.8' N, 06°28.8' W, 77 m, 2 shs; st 098, 60°54.4' N, 06°14.7' W, 150 m, 1 sh; st 100, 61°34.8' N, 06°17.0' W, 283 m, 1 sh; st 190, 62°42.8' N, 06°43.0' W, 250 m, 1 sh; st 354, 62°44.4' N, 06°11.9' W, 317 m, 1 sh; st 358, 61°59.8' N, 04°31.6' W, 300 m, 1 sh; Shetland, 1 sh (USNM 182294); Shetland, Skerries, 140 m, 1 sh (USNM 182297); --Shetland, 1864, 1 sh (USNM 182300); Shetland, west coast, 3 shs (USNM 182307); LIGHTNING Exp 1868 st 2, 60°24'N, 06°58' W, 300 m, 2 shs (USNM 182301); PORCUPINE Exp 1869 st 16, 54°19' N, 11°50' W, 1485 m, 1 sh (USNM 182303); western France, off Roscoff, Le Trou aux Raies, 2 spms (MNHN); PROCELT st K235, 47°29' N, 06°37' W, 313-330 m, 2 shs; --THALASSA st X353, 44°07' N, 04°45' W, 645 m, 1 spm; st X363, 44°06' N, 04°54' W, 590 m, 1 sh; st Y400, 40°46' N, 09°19' W, 810 m, 5 spms; st Z397, 47°34' N, 07°13' W, 511 m, 2 shs; st Z399, 47°35' N, 07°18' W, 825 m, 1 sh; st Z402, 47°40' N, 07°29' W, 450 m, 1 spm; st Z413, 48°03' N, 08°29' W, 805 m, 2 shs; st Z414, 48°05' N, 08°30' W, 650 m, 10 spms; st Z417, 48°12' N, 09°10' W, 865 m, 7 shs; st Z421, 48°23' N, 09°34' W, 950 m, 1 sh; st Z424, 48°28' N, 09°44' W, 475 m, 10 shs; st Z425, 48°28' N, 09°44' W, 700 m, 3 shs; st Z426, 48°28' N, 09°39' W, 860 m, 3



Figures 1439-1441. *Alvania jeffreysi*. **1439-1440**, off Korsfjorden, western Norway, 2.3 and 2.2 mm. **1441**, off northwestern Norway, 2.8 mm.

shs; st Z434, 48°41' N, 09°54' W, 720 m, 4 shs; st Z457, 48°38' N, 09°53' W, 800 m, 1 sh; SARSIA st 7615A, 43°42' N, 03°43' W, 330-340 m, 1 sh; PORCUPINE Exp 1870 st 17, 39°42' N, 09°43' W, 1092-1993 m, 10 shs (coll. Sykes, BMNH); --CAPBRETON 88 st DE05, 43°58' N, 02°05' W, 164 m, 5 shs; --DR29, 43°47' N, 02°01' W, 165 m, 2 shs.

Distribution: From off northernmost Norway, eastern, southern and western Iceland and off southeastern Greenland, south to Portugal, ca 40° N, usually in 50-300 m, more rarely down to 2000 m. Common in the northern part of its range, rare in the southern.

Remarks: Among the deep-sea rissoids, it is only *A. jeffreysi* and *Benthonellania gofasi* (Fig. 1590) which have a distinct zigzag sculpture on the larval shell. The shape of *A. jeffreysi* resembles *A. tarsodes*, from the Azores (Fig. 1442-6), but that species has a much finer microsculpture on the protoconch (Fig. 1450, 1452), not visible with a stereomicroscope.

Alvania jeffreysi has usually been correctly identified, but records from the Mediterranean (Jeffreys 1884) are based on *A. sororcula* (Granata, 1877), a species from more shallow water (Gofas & Warén 1982).

Alvania tarsodes (Watson, 1886) Figs 1442-1446, 1450, 1452

Rissoa (Alvania) tarsodes Watson, 1886:595, pl. 44 fig. 2.

Type material: Holotype BMNH 1887.2.9.1933-6.

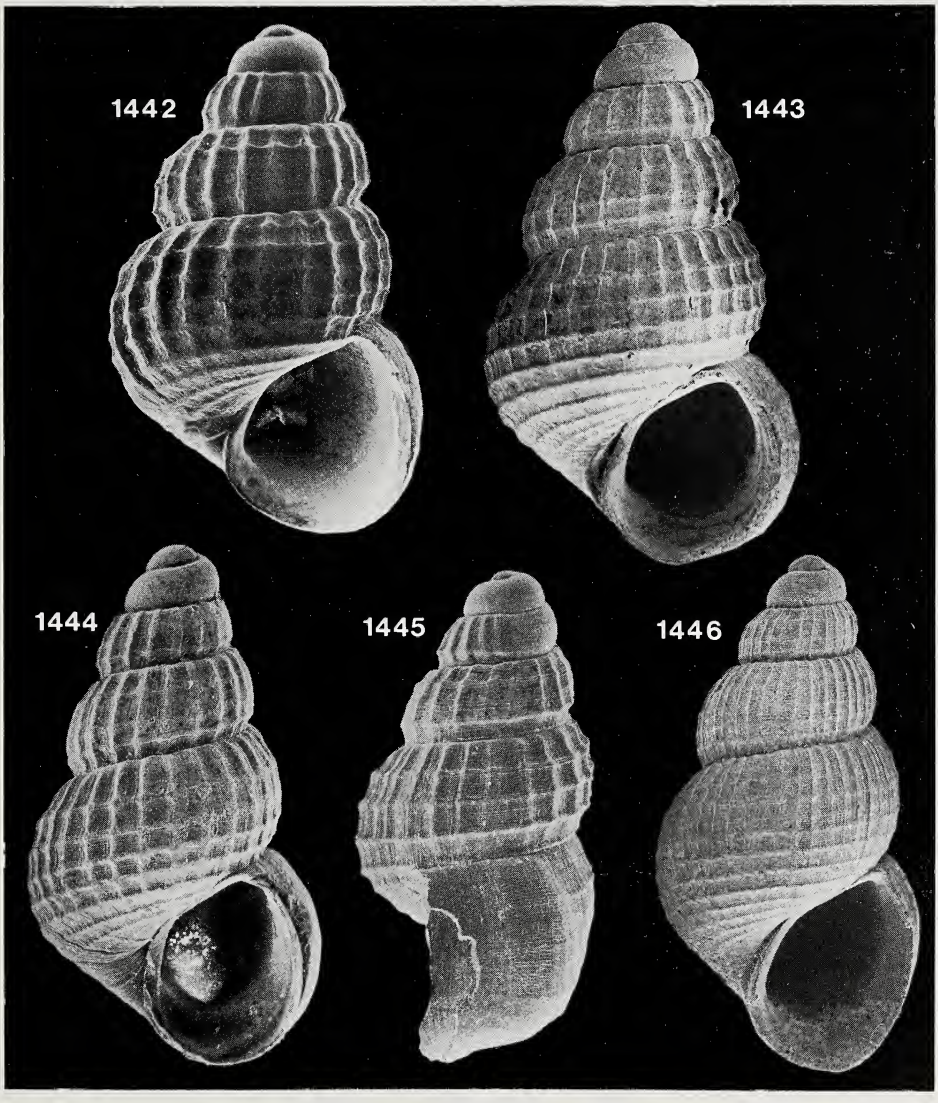
Type locality: CHALLENGER Exp st 75, 38°38' N, 28°28.5' W, 819-910 m, off Fayal, Azores.

Material examined: The types and --MONACO Exp st 198, 38°26' N, 30°59' W, 800 m, 1 sh

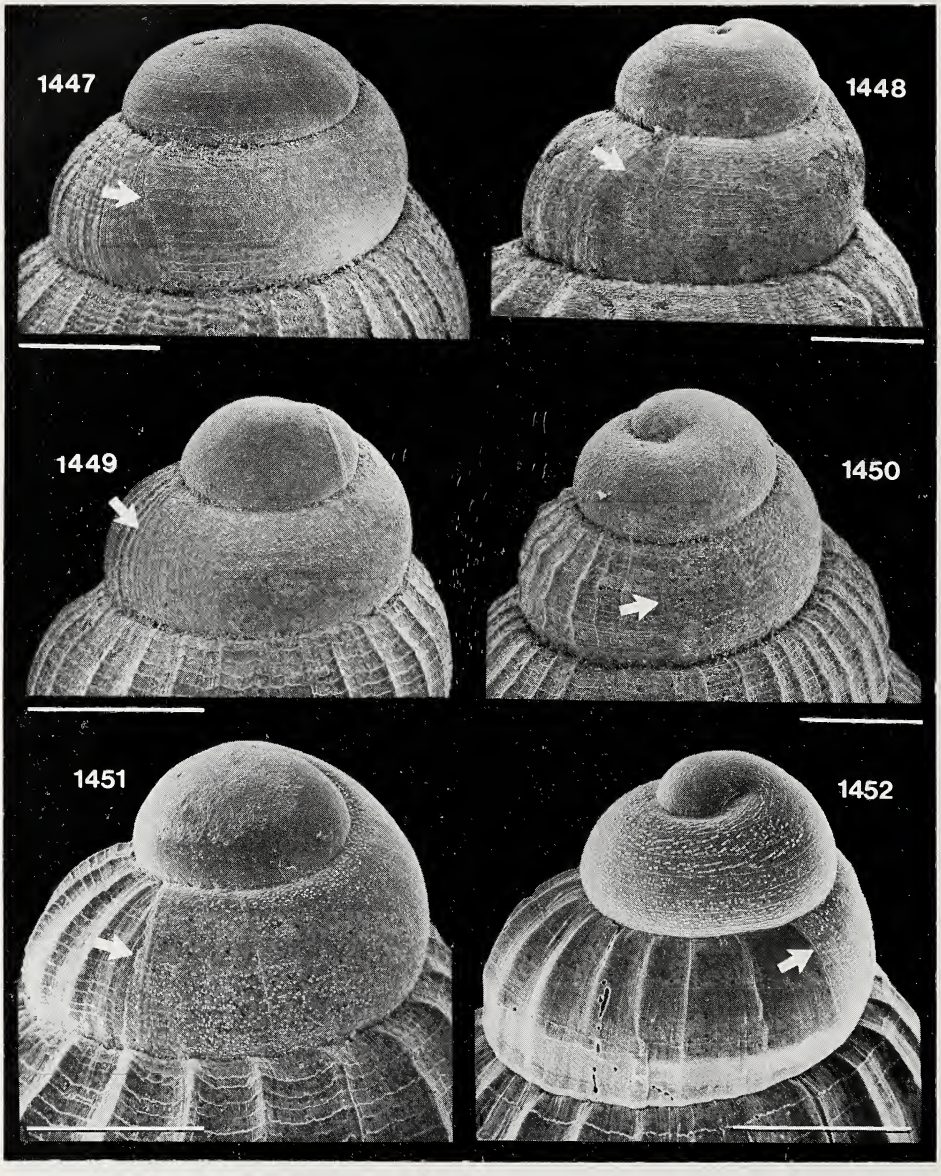
(MOM); st 553, 37°43' N, 25°05' W, 1385 m, 2 sh (MNHN), 2 shs (MOM), 1 sh (IRSN); st 2214, 39°26' N, 31°22' W, 914-650 m, 1 sh (IRSN); BARTLETT st 2, 37°14' N, 28°45' W, 480 m, 1 sh (ZMC); st 4, 38°10' N, 28°53' W, 800-750 m, 22 shs (ZMC).

Distribution: The Azores, in 480-1385 m.

Remarks: Dautzenberg (1927:133) listed 1 additional locality in the Azores, in 1600 m (material not seen). *Alvania tarsodes* resembles *A. jeffreysi*, but can be separated by not having zigzag lines on the larval shell, see *A. jeffreysi*.



Figures 1442-1446. *Alvania tarsodes*. **1442**, syntype, 2.0 mm. **1443-1445**, BARTLETT st 4, 2.1, 2.3 and 2.1 mm. **1446**, MONACO Exp st 2214, 2.1 mm.

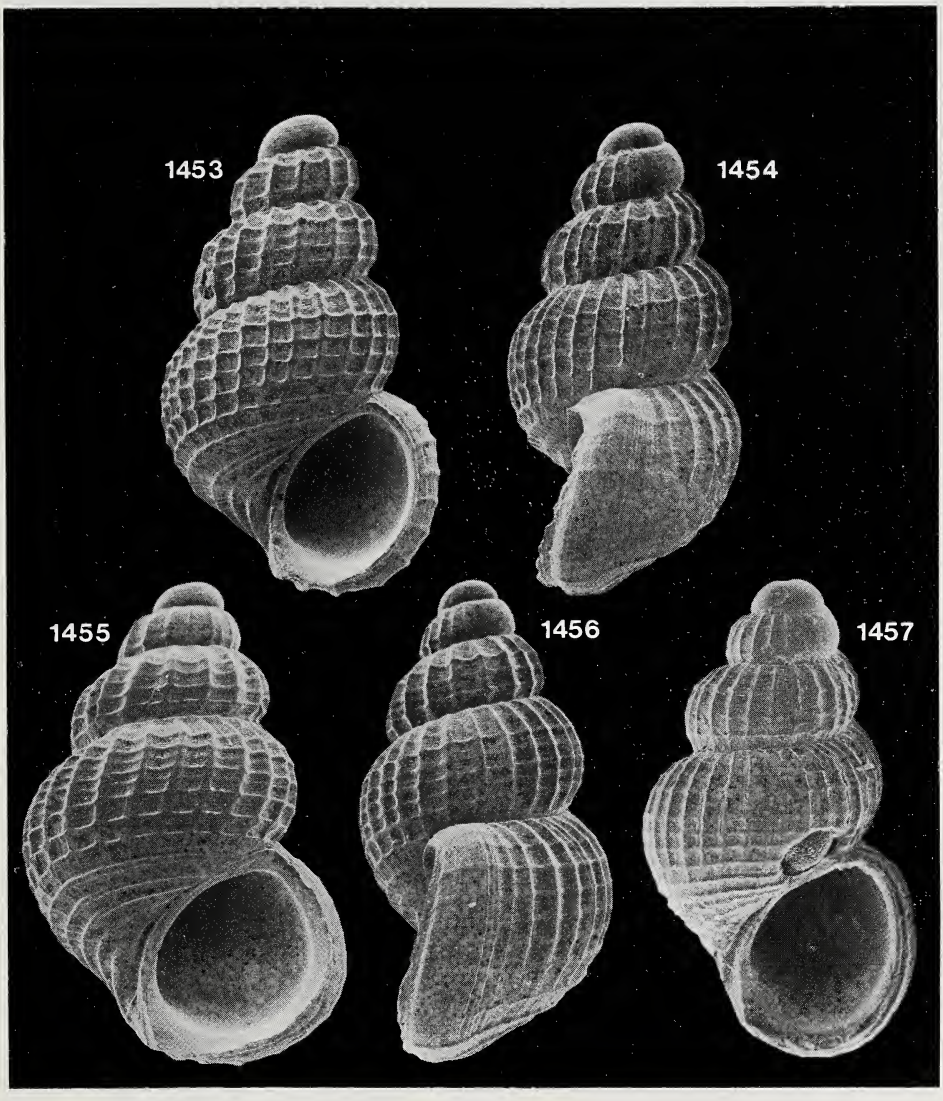


Figures 1447-1452. Protoconchs of *Alvania* and *Pusillina*. **1447,** *A. stenolopha*, MONACO Exp st 703. **1448,** *P. harpa*, 49°41'N, 52°09'W, 340 m. **1449,** *A. adinogramma*, SEAMOUNT st DW16. **1450,** *A. tarsodes*, MONACO Exp st 2214. **1451**, *A. cancapae*, CANCAP st 2.074. **1452,** *A. tarsodes*, BARTLETT st 2.

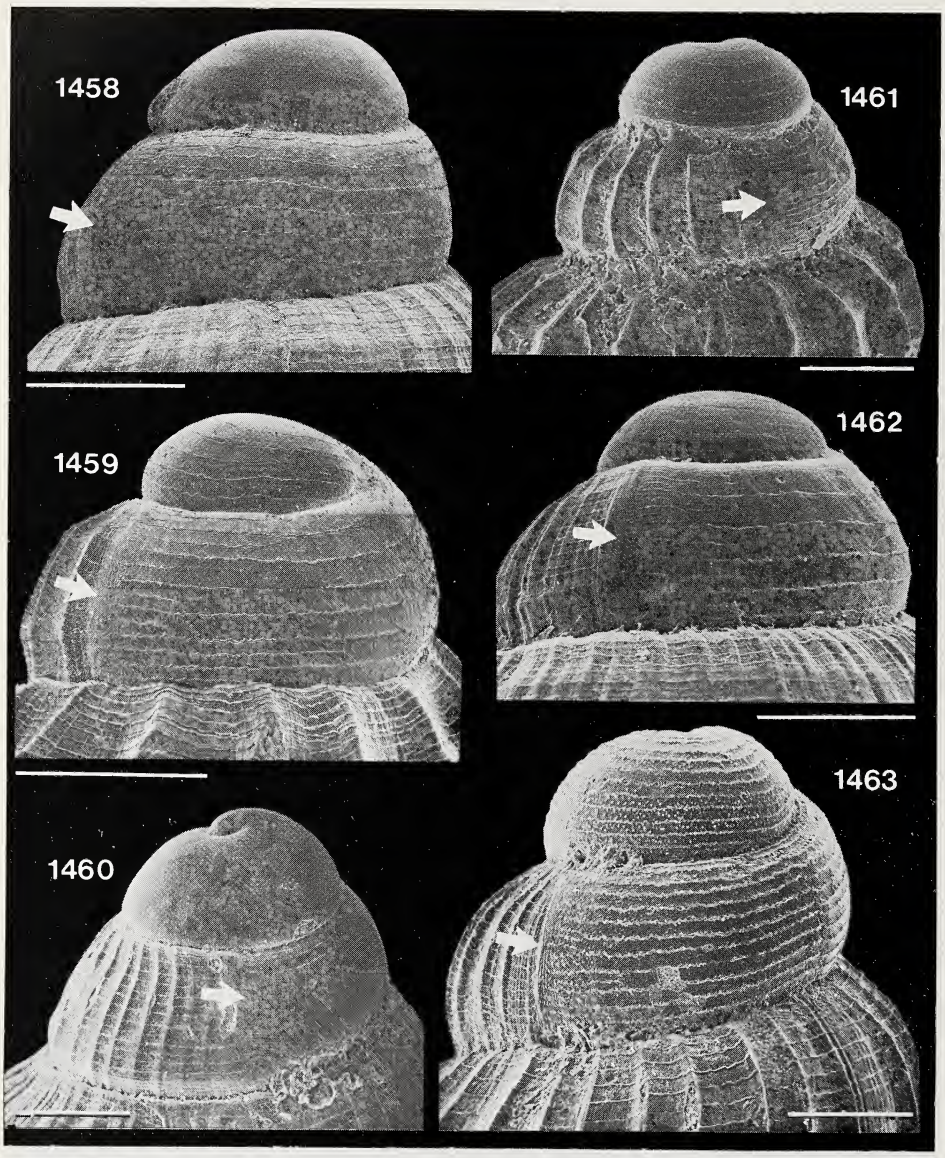
All scale lines 200 μm.

Alvania subsoluta (Aradas, 1847) Figs 1377, 1453-1461, 1464-1474

Rissoa subsoluta Aradas, 1847:77.
Rissoa elegantissima Seguenza, 1876:102. (Not *Rissoa elegantissima* Monterosato, 1875 = *Alvania electa*).
Rissoa subsoluta: Jeffreys 1884:115, pl. 9 fig. 3.
Alvania subsoluta: Oliverio *et al.* (in press).



Figures 1453-1457. *Alvania subsoluta*. **1453-1454**, Adventure Bank, both 2.0 mm (USNM 183683). **1455-1456**, Korsfjorden, western Norway, 2.7 and 2.5 mm. **1457**, 2.3 mm (USNM 183275 ex Seguenza).



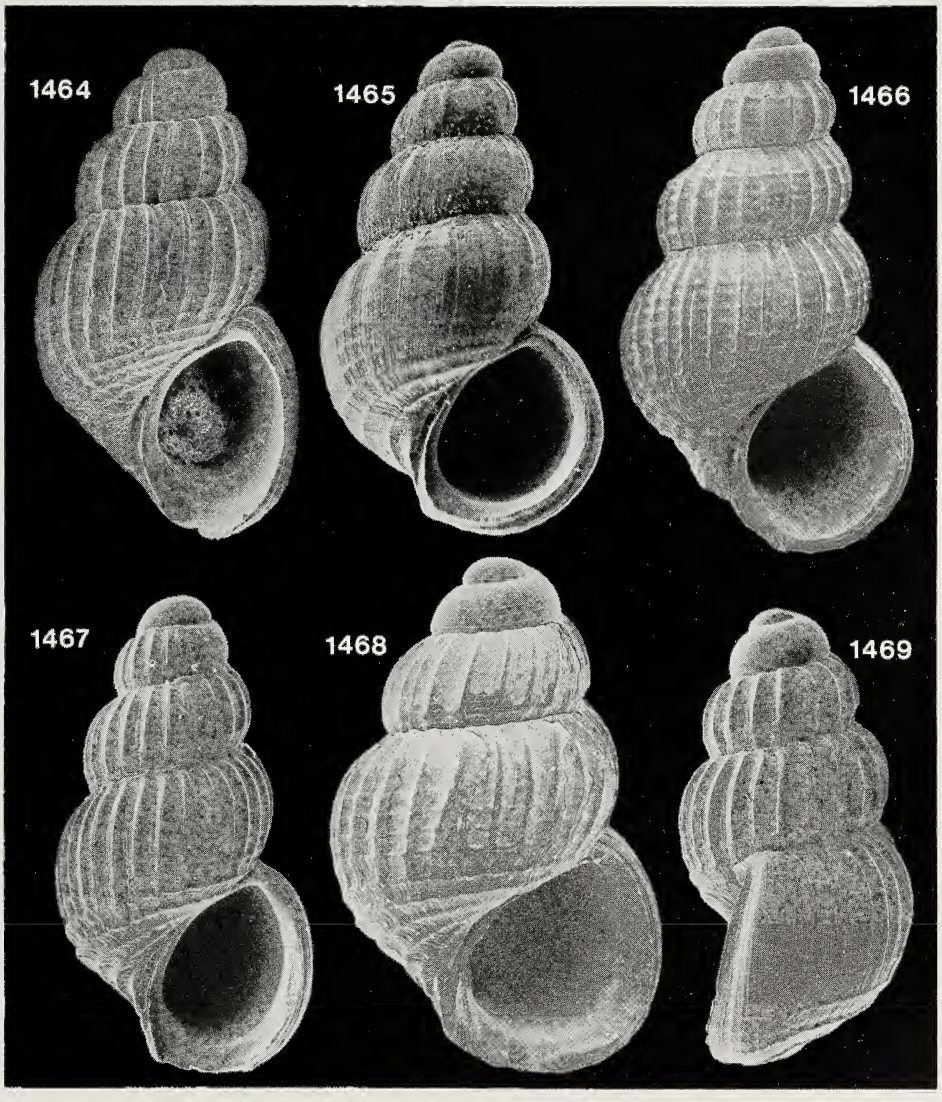
Figures 1458-1463. Protoconchs of *Alvania*. **1458,** *A. subsoluta*, BALGIM st CP30. **1459,** *A. subsoluta*, BALGIM st DW02. **1460**, *A.* cf. *subsoluta*, THALASSA st X339. **1461,** *A. subsoluta*, syntype of *A. elegantissima* Seguenza, Astiano (USNM 183275). **1462,** *A. wareni*, THALASSA st Y400. **1463,** *A. verrilli*, VÖRINGEN st 192.

All scale lines 200 μm.

The arrows indicate the protoconch - teleoconch demarcation.

Type materials: R. subsoluta, neotype selected by Oliverio *et al.* (in press); *R. elegantissima*, lectotype (selected by Oliverio *et al.* (in press)) and 11 paralectotypes in the Geological Museum of the University of Florence; paralectotypes, 2 lots, USNM 183274 and 183275.

Type localities: R. subsoluta, Plio-Pleistocene of Gravitelli, near Messina, Sicily; *R. elegantissima*, not designated, Plio-Pleistocene, Messina and Recent in the Mediterranean.



Figures 1464-1469. *Alvania subsoluta*. **1464**, SE Bay of Biscay, 1000 m, 2.3 mm. **1465**, THALASSA st X353, 2.1 mm. **1466**, BALGIM st CP95, 2.9 mm. **1467-1469**, BALGIM st DW02, 1.6 mm, 1.6 mm, and 1.5 mm.

Material examined: 194 lots with 4300 shells and specimens from all parts of the distributional area.

Distribution: From North Cape to the Canaries, also in the Mediterranean, usually in 200-1200 m, more rarely 80 m (northern localities) - 2000 m (southern localities). Not in the Azores, the Faroes or Iceland.

Remarks: Alvania subsoluta is a highly variable species, both in the shape of the shell and the sculpture. Figs 1467-1469 show a series of specimens from off southwestern Portugal. That sample contained 17 specimens, of which 5 belong to a very small form, more narrow, more weakly sculptured and with more convex whorls. Eleven specimens were of normal appearance and one was intermediate. Scattered specimens of the small slender type were found during the BALGIM expedition off northwestern Morocco and during THALASSA north of Spain (st X353, shape as small specimens but normal size). In the material from the PORCUPINE Exp 1870, Adventure Bank, 167 m, there were numerous small slender shells, but here the sculpture was of normal strength for the locality, and all transitions ocurred. Specimens from the southernmost localities we know of, have a very weak sculpture (Fig. 1471), but scattered specimens with weak sculpture occur also in the North (THALASSA st X339). These specimens are all from very deep water for the species and the variation seems to be clinal.

The specimen from THALASSA stn X339 (Figs 1460, 1473-1474), however, may more likely prove to be a distinct species, since the protoconch differs by having 1/3 of a whorl more than typical *subsoluta*, and in being more dome-shaped, a difference parallelling that beween *A. electa* and *A. porcupinae*.

The complicated history of the names *subsoluta* and *elegantissima* was elucidated by Oliverio *et al.* (in press) and we agree with their conclusions, which allow the names to be kept in their accustomed sense.

Alvania wareni (Templado & Rolan, 1986) Figs 1462, 1475

Rissoa (Cingula) affinis Jeffreys, 1884:124, pl. 9 fig. 8 (*pars*). (Not *Rissoa affinis* Aradas, 1847).
Rissoa affinis: Warén 1980:21.
Onoba wareni Templado & Rolan, 1986:122, fig. 6.

Type material: Holotype BMNH 85.11.5.1769.

Type locality: PORCUPINE Exp 1870 st 16, 39°55' N, 09°56' W, 1809 m.

Material examined: THALASSA st Y400, 40°46' N, 09°19' W, 810 m, 1 sh.

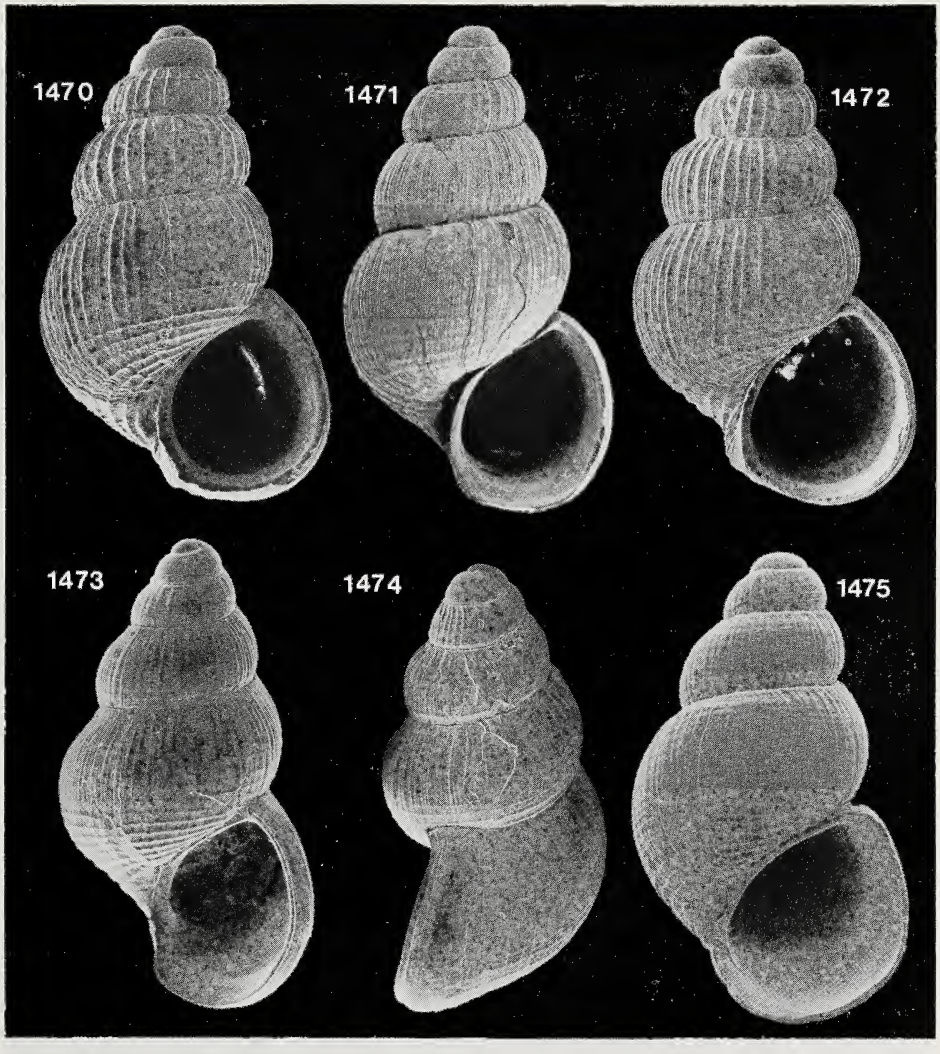
Distribution: Only known from the holotype and the material examined, from off western Portugal, in 800-1800 m.

Remarks: Rissoa affinis Jeffreys was based on a specimen each of two species. One came from shallow water in the Bay of Vigo and one from deep water off Portugal. The latter specimen was in poor condition and no additional, conspecific specimens were known. Therefore Warén (1980) designated the shallow water specimen as lectotype, to avoid nomenclatorial problems with the identity of the deep-water specimen.

Nevertheless Templado & Rolan (1986) introduced a new name for the deep-water specimen, despite not having any additional material to support the name. We refer to their figure of the fragmentary shell and complete their description with the facts that the shell is 2.56 mm high and the larval shell has a diameter of 470 μm. The holotype differs from our specimen from THALASSA st Y400 (Fig. 1475) in having slightly coarser sculpture and less expanded aperture. The protoconchs

are, however, similar as far as stereomicroscope examination can show.

Rissoa affinis Jeffreys was renamed *Rissoa spreta* by de Gregorio (1885:168), which is preoccupied by *R. spreta* Watson, 1873. Two further names have been introduced for the shallow water species from Vigo Bay, *Onoba vigoensis* Rolan, 1983 and *Alvania verduini* van Aartsen, 1983 slightly later. This is a shallow-water species (Figs 1498-1499, 1553), referred to *Manzonia* by Moolenbeek & Faber (1987), a systematic decision with which we agree.



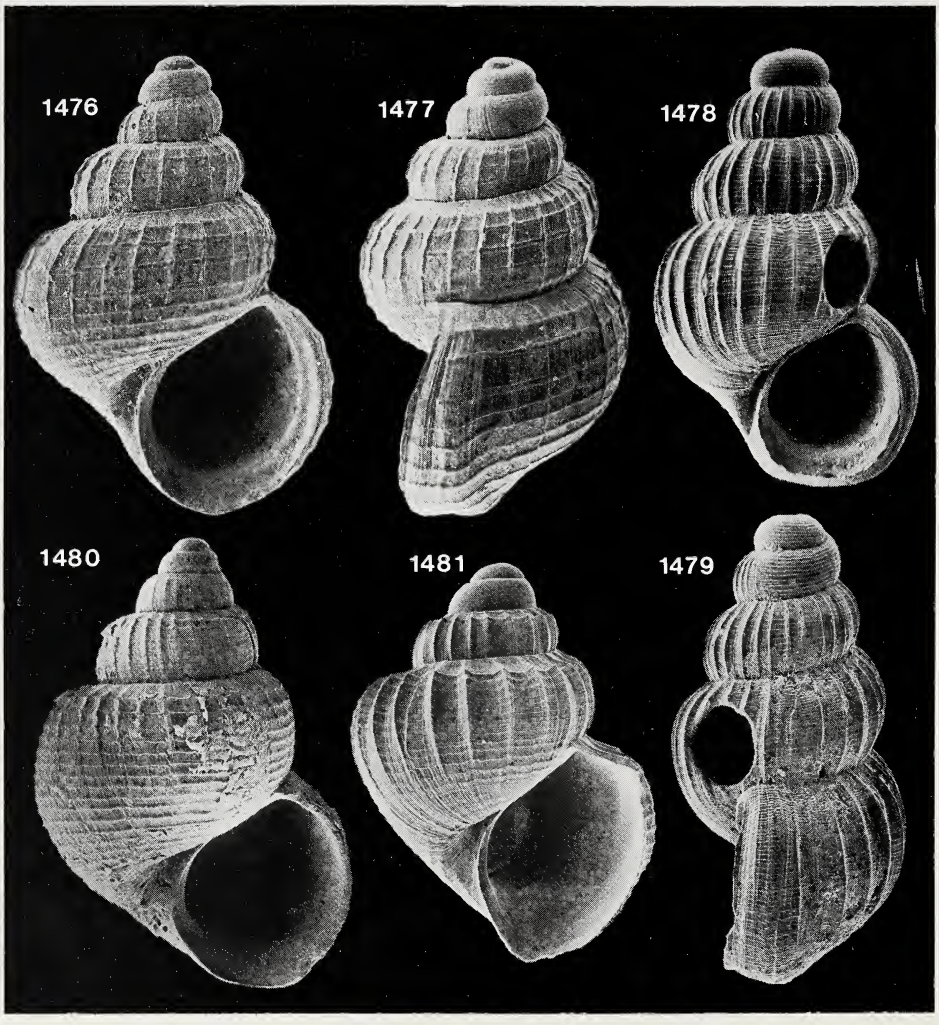
Figures 1470-1475. Genus *Alvania*. **1470,** *A. subsoluta*, CANCAP st 4.055, 3.1 mm. **1471,** *A. subsoluta*, SEAMOUNT st CP30, 2.8 mm. **1472,** *A. subsoluta*, BALGIM st CP68, 3.2 mm. **1473-1474,** *A. aff. subsoluta*, THALASSA st X339, 3.0 mm. **1475,** *A. wareni*, THALASSA st Y400, 2.4 mm.

Alvania pseudosyngenes Warén, 1973 Figs 1476-1477, 1489

Alvania pseudosyngenes Warén, 1973:8, figs 16, 17, 22-24.
Alvania pseudosyngenes: Warén 1974:133, figs 39-40.

Type material: Holotype ZMB 20833, seven paratypes ZMB 20833 and ZMO 29956, 1 paratype SMNH 4111.

Type locality: Off northern Norway, 69°46' N, 16°15' E, 1187 m.



Figures 1476-1481. Genus *Alvania*. **1476-1477,** *A. pseudosyngenes*, K. Oscars Fjord, NE Greenland, 3.2 and 3.3 mm. **1478-1479**, *A. verrilli*, VÖRINGEN st 192, 2.9 mm. **1480**, *A. wyvillethomsoni,* INGOLF st 103, 3.3 mm. **1481,** *A. wyvillethomsoni*, INGOLF st 59, 4.9 mm.

Material examined: Listed by Warén (1973) plus --a few additional shells from off western and southwestern Iceland in 200-400 m, in Icelandic private collections; off eastern Greenland, 65°17' N, 36°28' W, 199 m, 1 sh; eastern Iceland, 66°17' N, 12°15' W, 364 m, 1 sh; Denmark Strait, 66°51' N, 29°05' W, 321 m, 1 spm (all in the collection of J. Bógason).

Distribution: From eastern Greenland, 65-72° N, to southern Iceland and north of Lofoten, 200-2184 m (Warén 1973, 1974).

Remarks: Alvania pseudosyngenes can be recognised by the unusually broad shell and a sculpture of low and broad, axial and spiral ribs of comparable strength, neatly demarcating squares. *Alvania moerchi* (Collins, 1886) is an arctic shallow-water species of similar shape but with a more solid shell and only spiral sculpture.

Alvania verrilli (Friele, 1886) Figs 1463, 1478-1479

Rissoa verrilli Friele, 1886:27, pl. 11 fig. 5.
Alvania karlini Clarke, 1963:94, textfig. 1.
Alvania verrilli: Warén 1973:8, figs 20-21; Schiötte 1989:7, fig. 3G.

Type materials: R. verrilli, lectotype designated by Warén (1973), ZMB 20823 and 4 paralectotypes, ZMB 20823 and ZMO 4410; *A. karlini*, types in NMC (not seen).

Type localities: R. verrilli, NORWEGIAN NORTH ATLANTIC Exp st 192, North of Lofoten, 69°46' N, 16°15' E, 1187 m; *A. karlini*, North of Bering Strait, 77°12' N, 167°44' W, 527 m.

Material examined: The types of *R. verrilli*, and the material listed by Warén (1973) and Schiötte (1989).

Distribution: Arctic circumpolar, north of Spitsbergen and Franz Josef Land, north of Bering Strait and northeastern Greenland, in 180-1200 m.

Remarks: Alvania verrilli resembles *A. subsoluta* (Figs 1464-72) but has very sharp, straight axial ribs, very fine spiral sculpture and a coarsely striated protoconch. It also resembles *A. adinogramma* (Figs 1430-2), but is larger, has a proportionally larger aperture and a sculpture of spiral lines on the protoconch, instead of fine granules.

Alvania wyvillethomsoni (Friele, 1877) Figs 1480-1481, 1515

Rissoa Weyville Thomsoni (sic!) Friele, 1877:78, pl. 1 fig. 4 (radula).
Rissoa wyvillethomsoni: Friele 1879:274, pl. 4 fig. 6 (shell) (justified emendation).
Alvania wyvillethomsoni: Warén 1973:2, figs 1-4.
Rissoa wyvillethompsoni: Warén 1980:23 (misprint).
Alvania (Punctulum) wyvillethomsoni: Ponder 1985a:44, figs 25A, 97.

Type material: Lectotype (designated by Warén 1973) and 1 paralectotype, ZMB 20813.

Type locality: NORWEGIAN NORTH ATLANTIC Exp st 87, 64°02' N, 05°35' E, 535 m.

Material examined: Listed by Warén (1973, 1989b) and: --INGOLF Exp st 103, 66°23' N, 08°52' W, 1053 m, 3 spms (ZMC); st 105, 65°34' N, 07°31' W, 1387 m, 5 spms (ZMC); st 116, 70°05' N, 08°26'

W, 675 m, 1 spm, (ZMC); st 124, 67°40' N, 15°40' W, 901 m, 10 spms (ZMC); PORCUPINE Exp 1869 st 77, Shetland-Faroe Channel, 1019 m, 3 shs (USNM 183328); NORWEGIAN NORTH ATLANTIC Exp st 312, 74°54' N, 14°53' E, 1203 m, 2 shs (USNM 182612); south of Björnöya, 72°10' N, 20°37' E, 360-440 m, 1 sh (SMNH); off northern Iceland, Kolbeinsöy, 200-400 m, a few spms (coll. J. Björnsson); northern Iceland, 67°39' N, 19°04' W, 250 m, 1 sh; 67°16' N, 16°32' W, 296-324 m, 1 sh; 67°02' N, 22°38' W, 201-224 m, 1 sh; 66°12' N, 11°58' W, 310-322 m, 1 sh (all in coll. Jón Bogason); BIOFAR st 230, 61°09.0' N, 04°54.2' W, 750 m, 1 spm; --Sneli stn 1210-81, 69°41' N, 15°65' E, 1200-900 m, 2 spms; --stn 1204-81, 69°45' N, 16°33' E, 1050-700 m, 1 sh.

Distribution: Northeastern Greenland (Schiötte 1989), off northern and eastern Iceland, south to the Shetland-Faroe Channel, off western Norway to northern Norway, to North of Franz Josef Land, in about 300-2800 m, in the southern part in about 800 m and deeper (Warén 1974).

Remarks: Alvania wyvillethomsoni can be recognized by the large smooth larval shell (Fig. 1528), which despite having about two whorls, has no distinctly set off protoconch 1 and most likely has non-planktotrophic development. It is the type species of *Punctulum* Jeffreys, 1884, regarded as a subgenus of *Alvania* by Ponder (1985a). The well developed umbilicus, absence of labial rib and the shape of the shell closely resemble young specimens of several species of *Alvania* and we consider it neotenous in these aspects. This does not lead to problems with identification since *A. wyvillethomsoni* is almost twice as large as most adult specimens of *Alvania*.

Alvania adiaphoros sp.n. Figs 1485-1487, 1516

Type material: Holotype and 15 paratypes in MNHN.

Type locality: MONACO Exp st 2214, 39°26' N, 31°22' W, 914-650 m, the Azores.

Material examined: The types and --JOSEPHINE Exp, off Villafranca, Sao Miguel, Azores, 360-540 m, 1 sh (SMNH).

Distribution: Only known from the Azores in 360-914 m.

Description: Shell (Figs 1485-7) small, fairly solid, conical, colourless. Larval shell (Fig. 1516) dome-shaped, consisting of 1.5 whorls, sculptured by scattered microtubercles, to some extent arranged in bands. Teleoconch of 2.75 distinctly convex whorls, sculptured by straight, rather sharp axial ribs ending abruptly at adapical suture, abapically becoming weaker at and in the channelled suture, ending at the upper 1st-3rd spiral rib. Spiral sculpture of 4-7 spiral ribs at periphery and basal surface, strongest just below periphery. A few very narrow and irregularly disposed microstriae restricted to first teleoconch whorl. Suture channelled and deep. Aperture rounded and broad, with distinct parietal callus. Outer lip thickened.
Dimensions. Height of holotype 2.03 mm, breadth 1.26 mm, height of aperture 0.90 mm, breadth 0.63 mm.

Etymology: Adiaphoros (Greek) not different, neutral.

Remarks: Alvania adiaphoros is known from two localities only and only as empty shells. It shows some resemblance in shape to *C. amphiglypha* (Figs 1531-2), but is larger and has much stronger sculpture.

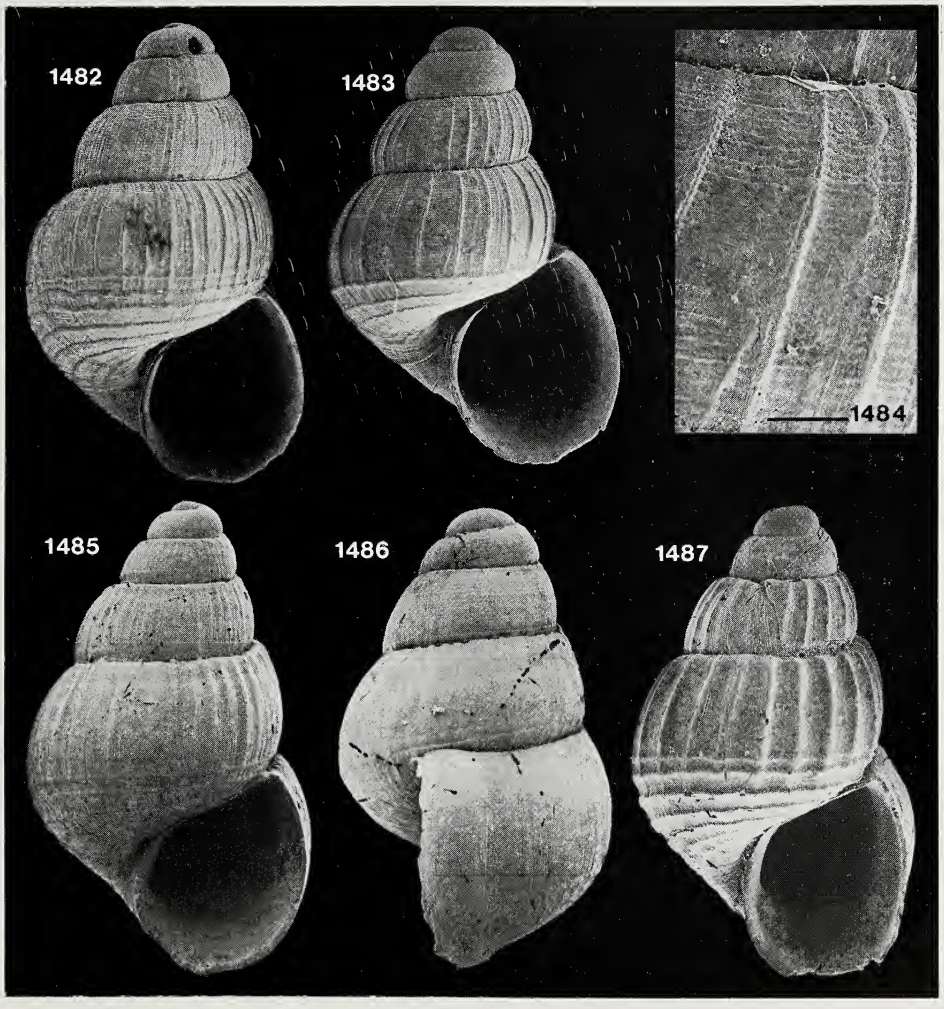
Alvania tarsodes from the Azores (Figs 1442-6) has a very similar protoconch (Figs 1450, 1452), but has a proportionally smaller aperture and distinctly reticulate sculpture. *Alvania stenolopha* (Figs 1482-4) has the same principal arrangement of the sculpture, but its larval shell (Fig. 1447) is sculptured by spiral lines, the ribs are much more slender and the whole shell is covered by a fine but distinct microstriation.

Alvania stenolopha sp.n. Figs 1447, 1482-1484

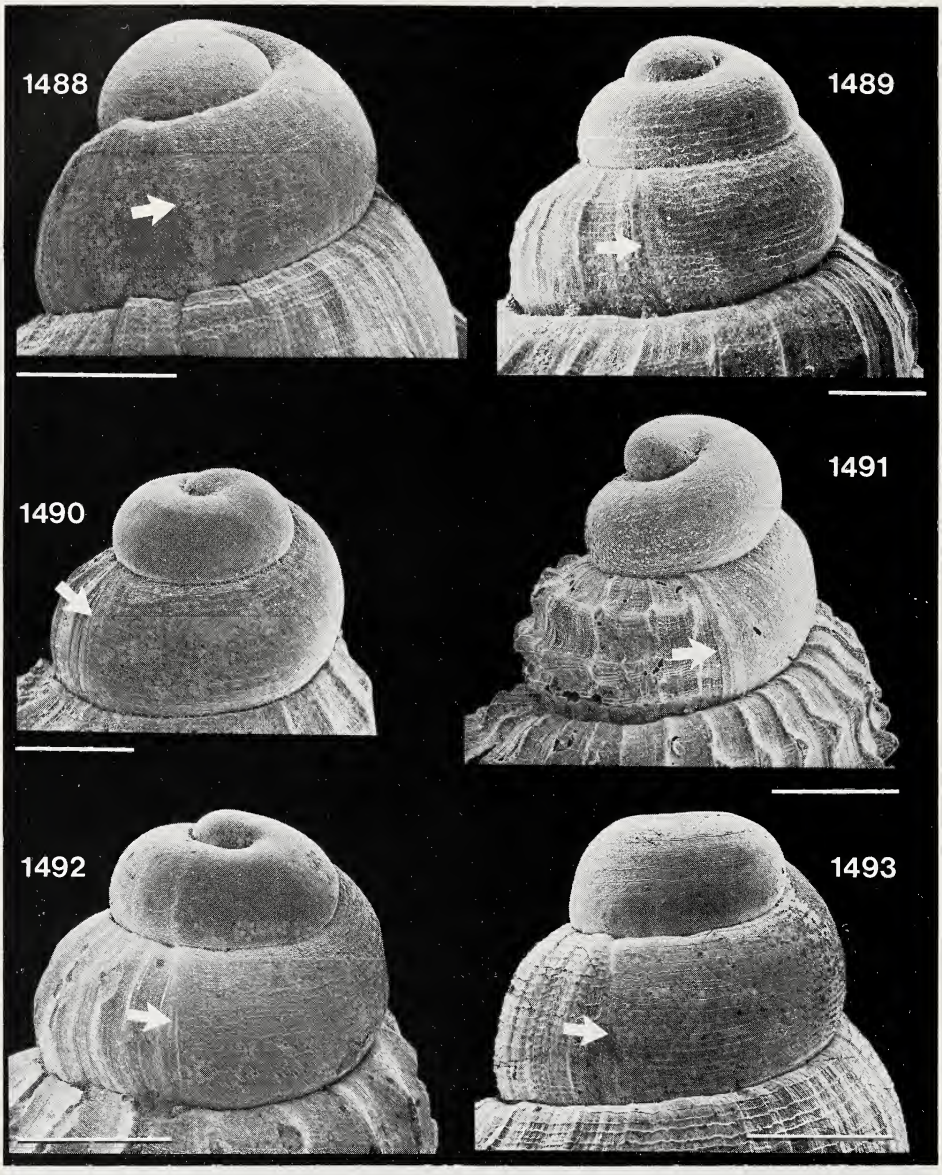
Type material: Holotype in MNHN.

Type locality: MONACO Exp st 703, 39°21' N, 31°06' W, 1360 m, the Azores.

Material examined: The types and --MONACO Exp st 2214, 39°26' N, 31°22' W, 914-650 m, 1 spm; st 719, Azores, 39°11' N, 29°06' W, 1600 m, 1 sh (MOM).



Figures 1482-1487. Genus *Alvania*. **1482,** *A. stenolopha*,, MONACO Exp st 719, 2.0 mm. **1483-1484,** *A. stenolopha*, holotype, 1.65 mm and microsculpture, scale line 100 μm. **1485,** *A. adiaphoros*, holotype, 2.0 mm. **1486-1487,** *A. adiaphoros*, MONACO Exp st 2214, 1.75 and 1.65 mm.



Figures 1488-1493. Genera *Onoba* and *Alvania*: protoconchs. **1488**, *O. aculeus*, southwestern Iceland. **1489,** *A. pseudosyngenes*, K. Oscars Fjord, northeastern Greenland. **1490,** *A. pseudoareolata*, northwestern Iceland. **1491,** *A. lamellata*, holotype. **1492**, *A. pseudoareolata*, Trinity Bay, Newfoundland (SMNH). **1493,** *O. islandica*, off southwestern Iceland.

Scale lines 200 μm.

The arrows indicate the protoconch - teleoconch demarcation.

Distribution: Only known from the material examined, from the Azores, in 900-1600 m.

Description: Shell (Figs 1482-4) small, fragile, bluntly conical with large aperture. Larval shell (Fig. 1447) dome-shaped, consisting of 1.4 whorls sculptured by about 15 very fine spiral lines and of a diameter of 460 μm. Teleoconch with 2.4 evenly convex whorls, separated by a distinct suture. All surface covered by very fine but distinct spiral lines. 4-8 stronger spiral cords at and below periphery. About 20 axial ribs on body-whorl, sharp and narrow, separated by 5-6 times as broad interspaces, and stopping abruptly at 1st-3rd spiral cord. Aperture large, expanded, parietal callus concealed but well developed. Outer lip not thickened, destitute of axial ribs for 1/10 of a whorl. Umbilicus variable.
Dimensions. Height of holotype 1.66 mm, breadth 1.18 mm, height of aperture, 0.82 mm, breadth 0.64 mm.

Etymology: Stenos (Greek) - narrow, *lopha* (Greek) - rib, ridge.

Remarks: Alvania stenolopha shows a general resemblance to *A. adiaphoros* (Figs 1485-7) but has a much more fragile shell with more narrow ribs, spiral lines on the protoconch instead of microgranules (Fig. 1529) , and has a larger aperture without labial rib.

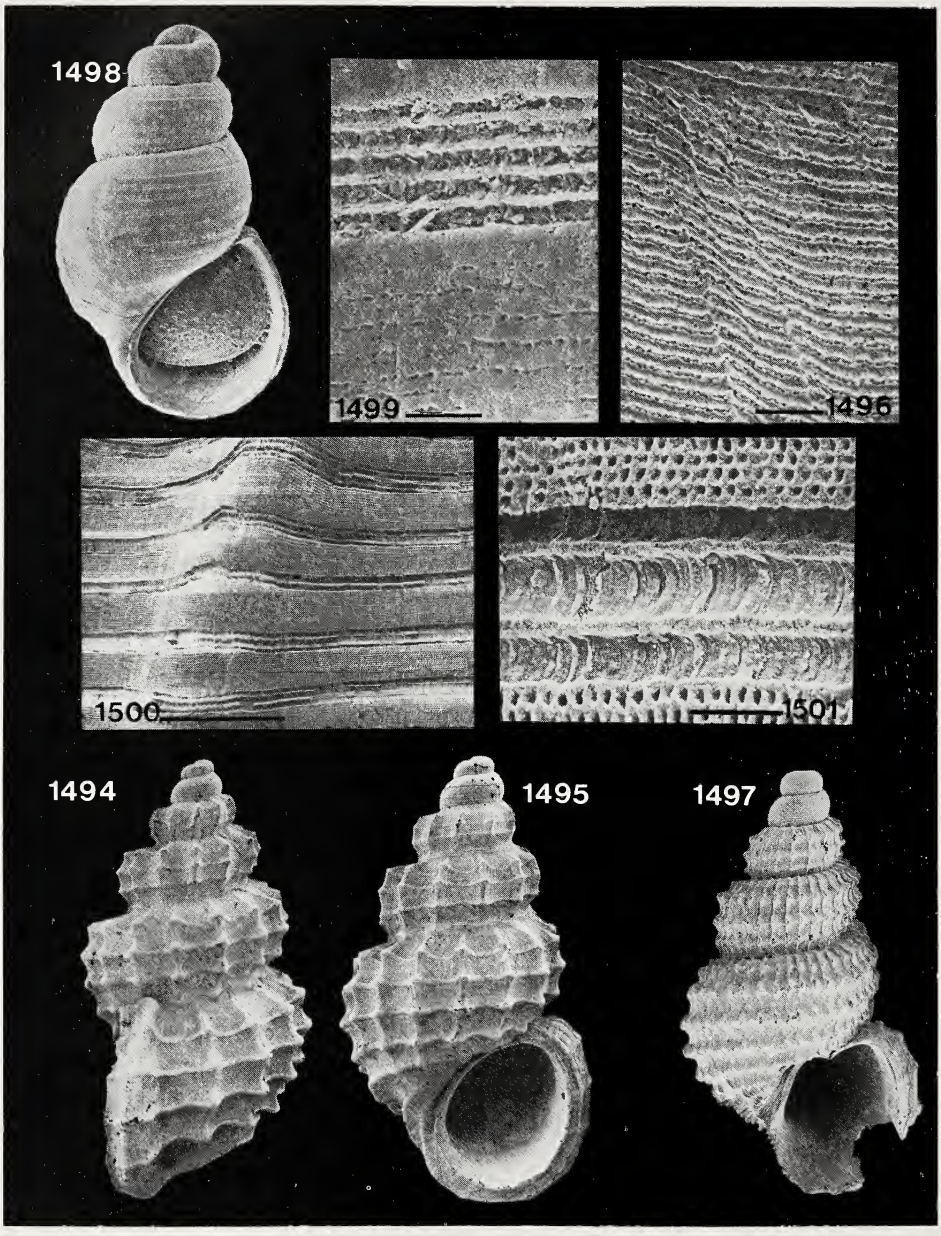
Alvania zetlandica (Montagu, 1815) Figs 1494-1496, 1502

Turbo zetlandicus Montagu, 1815:194, pl. 13 fig. 3.
Rissoa cyclostomata Récluz, 1843:104.
Rissoa canaliculata Philippi, 1844a:223, pl. 28 fig. 19 (synonym according to Jeffreys 1884:116).
Rissoa scalariformis Metcalfe in Thorpe, 1844:XLII.
Rissoa carinata Aradas, 1847:74 (synonym according to Monterosato 1878:85). (Not *R. carinata* Philippi, 1836).

Type materials: T. zetlandicus, lost (see Remarks, below); *R. cyclostomata*, lost ?; *R. canaliculata*, not in ZMHU; *R. scalariformis*, not known; *R. carinata*, not known.

Type localities: T. zetlandicus, Noss, Shetland, British Isles; *R. cyclostomata*, Cherbourg, France; *R. canaliculata*, fossil (Plio-Pleistocene?) in Tarento, southern Italy; *R. scalariformis*, Herm, near Guernsey, Channel Islands; *R. carinata*, Plio-Pleistocene of Gravitelli, near Messina, Sicily.

Material examined: Norway, north to just north of Lofoten, (NORWEGIAN NORTH ATLANTIC Exp st 173b), 36-540 m, 50 samples, 300 spms (SMNH, ZMC, ZMB, ZMO); --Swedish west coast, 30-200 m, 12 lots, 25 shs (SMNH); --THALASSA st X322, 44°00' N, 04°45' W, 1030 m, 13 shs; st Z397, 47°34' N, 07°13' W, 511 m, 6 shs; st Z399, 47°35' N, 07°18' W, 825 m, 7 shs; st Z402, 47°40' N, 07°29' W, 450 m, 1 sh; st Z413, 48°03' N, 08°29' W, 805 m, 22 shs; st Z414, 48°05' N, 08°30' W, 650 m, 4 shs; st Z415, 48°07' N, 08°26' W, 380 m, 1 sh; st Z417, 48°12' N, 09°10' W, 865 m, 42 shs; st Z424, 48°28' N, 09°44' W, 475 m, 5 shs; st Z425, 48°28' N, 09°44' W, 700 m, 1 sh; st Z427, 48°27' N, 09°48' W, 330 m, 4 shs; st Z428, 48°27' N, 10°50' W, 850 m, 1 sh; st Z431, 48°38' N, 09°47' W, 800 m, 1 sh; st Z435, 48°40' N, 09°53' W, 1050 m, 1 sh; st Z458, 48°42' N, 09°53' W, 350 m, 2 spms; --SEAMOUNT st CP20, 36°34' N, 11°30' W, 305-320 m, 1 sh; --st DW111, 42°40' N, 11°36' W, 675-685 m, 11 shs; --CANCAP st 2.074, 28°02' N, 14°29' W, 530 m, 1 sh; --BALGIM st DW128, 35°35' N, 03°45' W, 480 m, 8 shs; st DW132, 35°26' N, 04°19' W, 170 m, 12 shs; st DW134, 35°26' N, 04°17' W, 205 m, 1 spm; st CP135, 35°26' N, 04°14' W, 395 m, 2 shs; off Sicily, 100 m, 13 shs (SMNH); --S France, off Banyuls, Rech Lacaze, 200-400 m, 2 lots, 14 shs (SMNH); --Corsica, Baie de Calvi, 70-150 m, 1 sh (SMNH).



Figures 1494-1501. Genera *Alvania* and *Manzonia*. **1494-1496,** *A. zetlandica*, BALGIM st DW128, 3.0 and 3.4 mm, and microsculpture. **1497,** *A. lamellata*, holotype, 2.15 mm. **1498-1499**, *M. vigoensis*, Vigo Bay, NW Spain, 1.6 mm and microsculpture. **1500-1501,** *M. crassa*, Ceuta, Strait of Gibraltar, microsculpture.

Scale lines 50 μm (1500) and 10 μm (1496, 1499, 1501).

Distribution: Norway, from Lofoten, along the European west coast, south to the Canaries and in the western Mediterranean, usually in 30-300 m, occasionally down to 1000 m. Not in Iceland, the Faroes or the Azores.

Remarks: There are 3 shells labelled *Turbo zetlandicus* in the Montagu collection (Royal Albert Memorial Museum, Exeter; cat. no 4215). One is *Alvania cimicoides*, and two are *A. cancellata*. We suppose that these specimens were placed in the collection after the death of Montagu since his figure clearly shows the characters of his species as interpreted here, and therefore we keep using that name in the accustomed sense.

Philippi's *R. canaliculata* has constantly been identified with *A. zetlandica*, although we can see very little similarity between Philippi's figure and *A. zetlandica*.

Alvania zetlandica is the type species of *Flemellia* Nordsieck, 1972.

Alvania zetlandica has usually been classified in *Manzonia* Brusina, 1870 (type species by original designation *Turbo costatus* J. Adams, 1797 (not von Salis Marschlins, 1793) [= *Turbo crassus* Kanmacher, 1798]) (Ponder 1985a). Moolenbeek & Faber (1987) questioned this position and placed the subgenus *Flemellia* in *Alvania*. They have pointed out and figured the characteristic microsculpture of the European species of *Manzonia*. We show this in Figs 1499-1501. It consists of neatly aligned square pits, about 1 μm wide. Zones of 10-20 of these pits form flat spiral surfaces, separated by one or several shallow and sharply demarcated spiral furrows with a lamellar structure across the furrows. This kind of sculpture is, however, not restricted to *Manzonia* s.s., but occurs in a very similar design in species as different as *Alvania* aff. *canariensis* (d'Orbigny) from Madeira, and *Gofasia* spp. A similar surface structure occurs also in many Rissoininae (Ponder 1985a:figs 137, 141; Faber 1990; Warén unpublished). We therefore believe that the sculpture may be a symplesiomorhy, retained in *Manzonia* and scattered lineages.

We figure the microsculpture of *Alvania zetlandica* at the same magnification in Fig. 1496, to show that it is quite different, only consisting of narrow, sharp, irregular spiral ridges, separated by interspaces of the same width as the ridges. We believe that *A. zetlandica* is more closely related to *Alvania tomentosa* (Figs 1406-8), as indicated by the shape of the aperture and the sculpture. Serge Gofas has examined alive animals of both species and the soft parts are quite similar.

Alvania lamellata Dautzenberg, 1889 Figs 1491, 1497

Alvania lamellata Dautzenberg, 1889:50, pl. 3 fig. 5a-b.

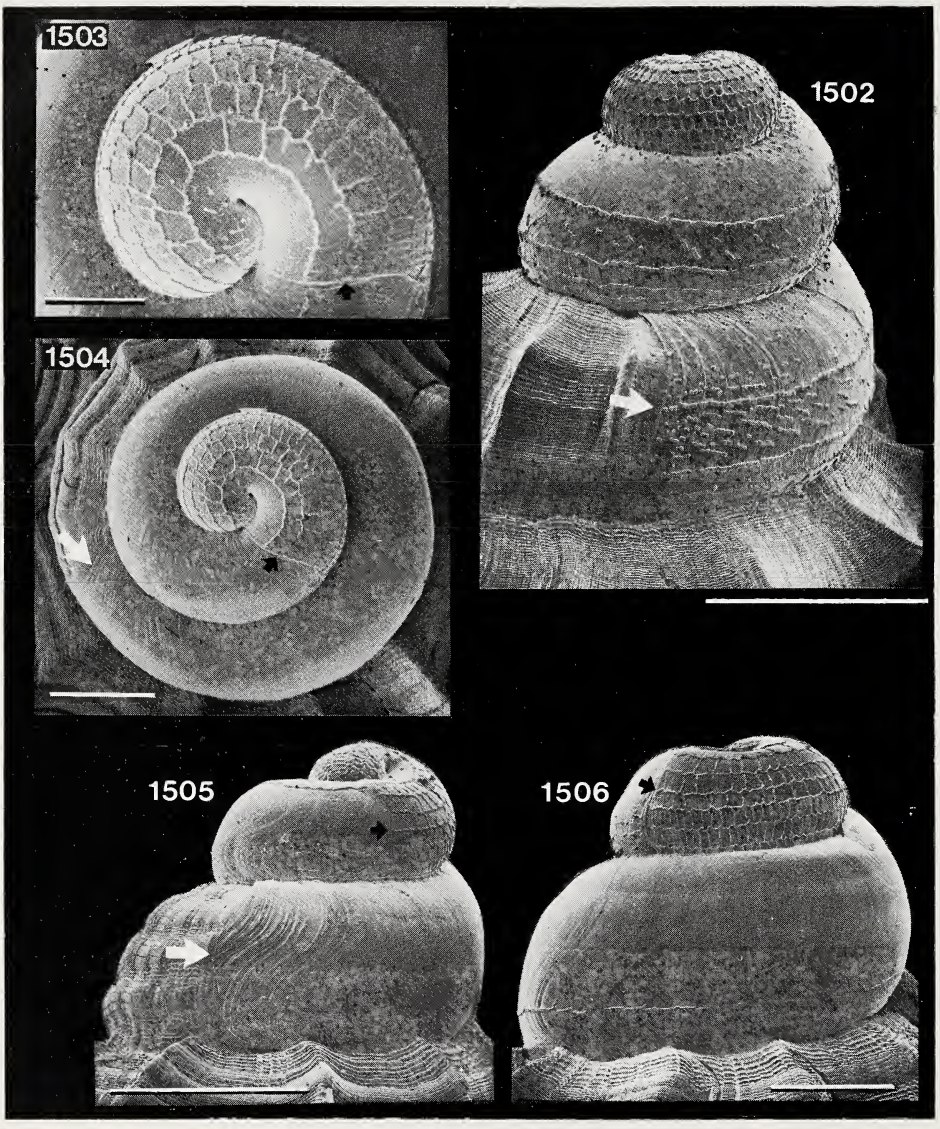
Type material: Lectotype, here designated, the shell figured by Dautzenberg, in MOM, 1 paralectotype in IRSN.

Type locality: MONACO Exp st 112, 38°34' N, 28°06' W, 1287 m.

Material examined: The type material.

Distribution: Only known from the type lot, from almost 1300 m depth, in the Azores.

Remarks: Alvania lamellata was described from two empty shells. It differs from all Rissooidea we have examined in the sharply granular sculpture of the protoconch and the sharp axial lamellae of the teleoconch, and we are not convinced that the species belongs to the Rissooidea. None of the specimens contained soft parts for examination of the radula.



Figures 1502-1506. Protoconchs of *Alvania* and *Manzonia*. **1502**, *A. zetlandica*, BALGIM st DW128. **1503-1506,** *M. crassa*, Ceuta, Strait of Gibraltar.

Scale lines 200 μm (1502, 1505), 100 μm (1504,1506), 50 μm (1503).

The black arrows indicate the protoconch I - protoconch II demarcation. The white arrows indicate the protoconch II - teleoconch demarcation.

Genus *ONOBA* H. & A. Adams, 1852

Onoba H. & A. Adams, 1852:358. Type species, by monotypy, *Turbo striatus* J. Adams, 1797 (not Da Costa, 1778) = *Turbo semicostatus* Montagu, 1803. European.

Remarks: Ponder (1985a) (and Neave 1940) suggested *Onoba* to be a replacement name for "*Turbonilla*, Leach non Risso". As far as we can see, the Adams brothers' synonymy ["Genus *Onoba*, nobis. (*Turbonilla*, Leach non Risso)"] must mean that *Onoba* was introduced with *Turbonilla* sensu Leach as a synonym, since they wrote about *Rissoa*: "Genus Rissoa, Freminville (*Acme*, Hartm.)".

Our interpretation means no difference for the type species of *Onoba*, which becomes "*Rissoa striata* [(Adams, 1797]", the only cited example, by monotypy. If the name is to be interpreted as a replacement name, Leach's *Turbonilla* cannot date to Leach in Gray 1847a, since it is there neither described nor cited in connection with a valid name. If it is considered to replace *Turbonilla* Leach in Gray, 1847b, we encounter the problem that *Turbonilla* Leach beside being a junior homonym, is introduced in synonymy. Here, however, Gray gives "*Turbo striatus* Montag." as type species.

We have used *Onoba* as a genus despite that conchologically we can see no great difference from certain species included in *Alvania*, for example *A. subsoluta*. This is done adviced by Ponder and Gofas (pers. comm.), who have found anatomical differences between *A. subsoluta* and *O. semicostata* (Ponder 1985) and consider the similarity in shell characters to be convergence. The anatomy is, however, still unknown for most of the species and our division of the species between *Alvania* and *Onoba* is therefore necessarily based on shell characters.

Onoba islandica (Friele, 1886) Figs 1493, 1508-1511

Rissoa islandica Friele, 1886:28, pl. 11 figs 8-9.
Alvania islandica: Warén 1973:4, figs 13-14.

Type material: Holotype ZMB 20858.

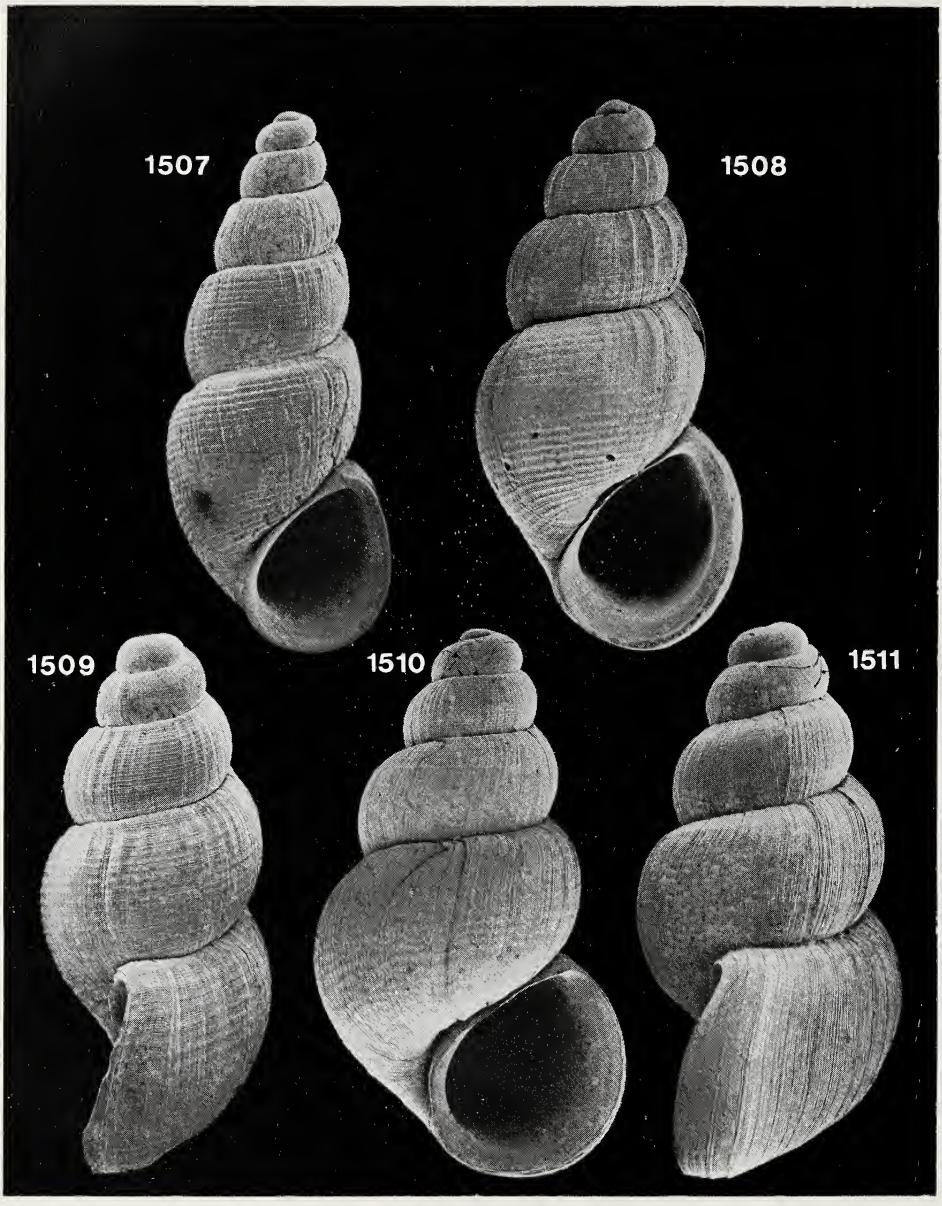
Type locality: Off eastern Iceland, 64°36' N, 10°22' W, 547 m.

Material examined: The holotype and --southwestern Iceland, off Jökultunga, Faxafloi and Reykjanes Ridge, 130-360 m, numerous shells (coll. Hans Larsen); --eastern Iceland, 64°38' N, 10°55' W, 419 m, 1 sh (coll. J. Bogason); BIOFAR stn 015, 62°38' N, 04°40' W, 683 m, 2 spms; --stn 082, 60°31' N, 08°25' W, 732 m, 4 shs.

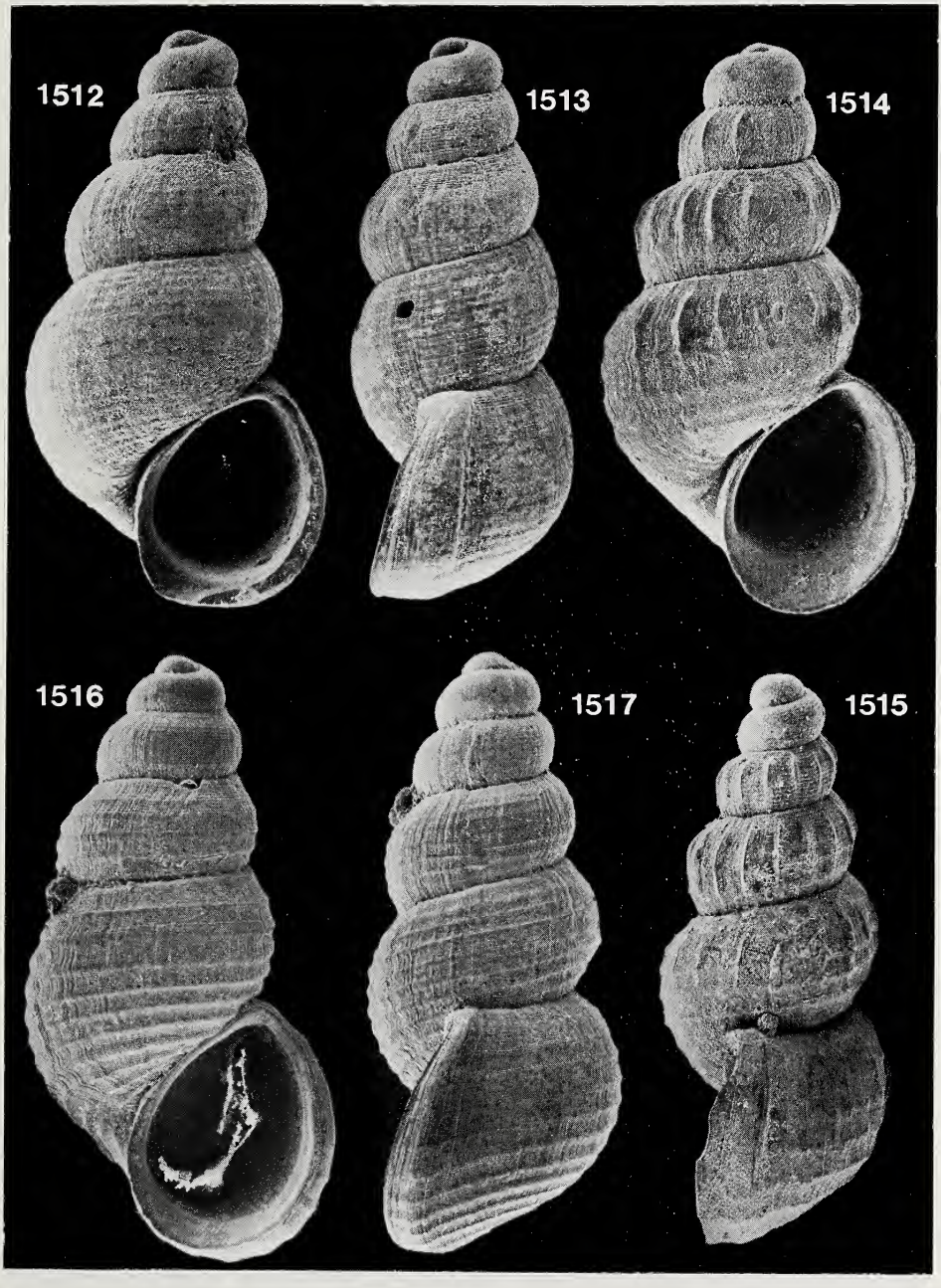
Distribution: Only known from off western, southern and eastern Iceland, and south of the Faroes, in 130-730 m.

Remarks: Onoba islandica is confusingly similar to *O. aculeus* (Fig. 1507), and frequently has a thick, brownish periostracum, as that species. It differs mainly in being less variable, more stout, having a more thickened outer lip, and in having half a whorl more in the larval shell. We figure *Onoba aculeus* for comparison in Figs 1488 and 1507.

We are nevertheless convinced that *O. islandica* is a good species, despite that Warén (1974:figs 41-42) erroneously figured a specimen as *Alvania leptalea*. *Onoba islandica* differs from that species (Figs 1516-1517) in having a stouter shell with less prominent sculpture.



Figures 1507-1511. Genus *Onoba*. **1507**, *O. aculeus*, Reykjavik, Iceland, 3.2 mm. **1508-1509,** *O. islandica*, off SW Iceland, 2.8 mm. **1510-1511,** *O. islandica*, off SW Iceland, 2.9 mm.



Figures 1512-1517. Genus *Onoba*. **1512-1513,** *O. leptalea*, INGOLF st 116, 3.8 mm. **1514,** *O. obliqua*, INGOLF st 116, 3.9 mm. **1515,** *O. obliqua*, INGOLF st 5, 3.9 mm. **1516-1517,** *O. leptalea*, J. Brönlunds Fjord, NE Greenland, 3.3 and 3.7 mm.

Onoba leptalea (Verrill, 1884) Figs 1512-1513, 1516-1517, 1527

Cingula leptalea Verrill, 1884:182, pl. 32 fig. 10.
Alvania leptalea: Warén 1974:133, except figs 41-42.

Type material: Holotype, USNM 38060.

Type locality: 41°53' N, 65°35' W, 1550 m.

Material examined: The material listed by Warén (1974), plus --northern Greenland, Jörgen Brönlund Fjord, 50 m, 3 spms (ZMC);western Iceland, Koluall, 300 m, 1 sh; --southwestern Iceland, Reykjanes Ridge, 800 m, 1 sh; northern Iceland, 67°03' N, 19°31' W, 438 m, 1 sh (all in coll. Jón Bogason).

Distribution: From off Massachusetts to northern Greenland, southwestern and northern Iceland, and Jan Mayen. Depth range 300-1600 m, occasionally 50 m.

Remarks: Warén (1974, figs 41-42) erroneously figured a specimen of *O. islandica* under the name *Alvania leptalea*. For differences from *O. islandica*, see that species. *Onoba obliqua* (Figs 1514-5) has distinct axial sculpture, and a more cylindrical shell.

Onoba obliqua (Warén, 1974) Figs 1514-1515

Alvania obliqua Warén, 1974:130, figs 45-46.

Type material: Holotype in ZMC, two paratypes in ZMC and SMNH 4112.

Type locality: INGOLF Exp st 116, 70°05' N, 08°26' W, 670 m, off Jan Mayen.

Material examined: Listed by Warén (1974), plus: northern Iceland, 67°17' N, 19°14' W, 520 m, 1 sh; northern Iceland, 66°35' N, 13°26' W, 216 m, 2 shs; northern Iceland, 66°17' N, 12°15' W, 415 m, 1 sh (all in coll. Jón Bogason).

Distribution: Off western Greenland, northern Iceland and Jan Mayen, in 63-686 m.

Remarks: Onoba obliqua is characterized by its axial sculpture, slender shape and somewhat distorted appearance.

Onoba gianninii (Nordsieck, 1974) Figs 1518-1521, 1525

Setia (Crillosetia) gianninii Nordsieck, 1974a:11, fig. 4.
Cingula gianninii: Verduin 1984:61, figs 25, 74.

Type material: Lectotype (Amati & Nofroni 1991:32) in ZMR, 1 paralectotype in coll. Giannini, Empoli, Italy (not seen); paratypes also in coll. Carrozza, van Aartsen and SMNH, the latter two from Carrozza.

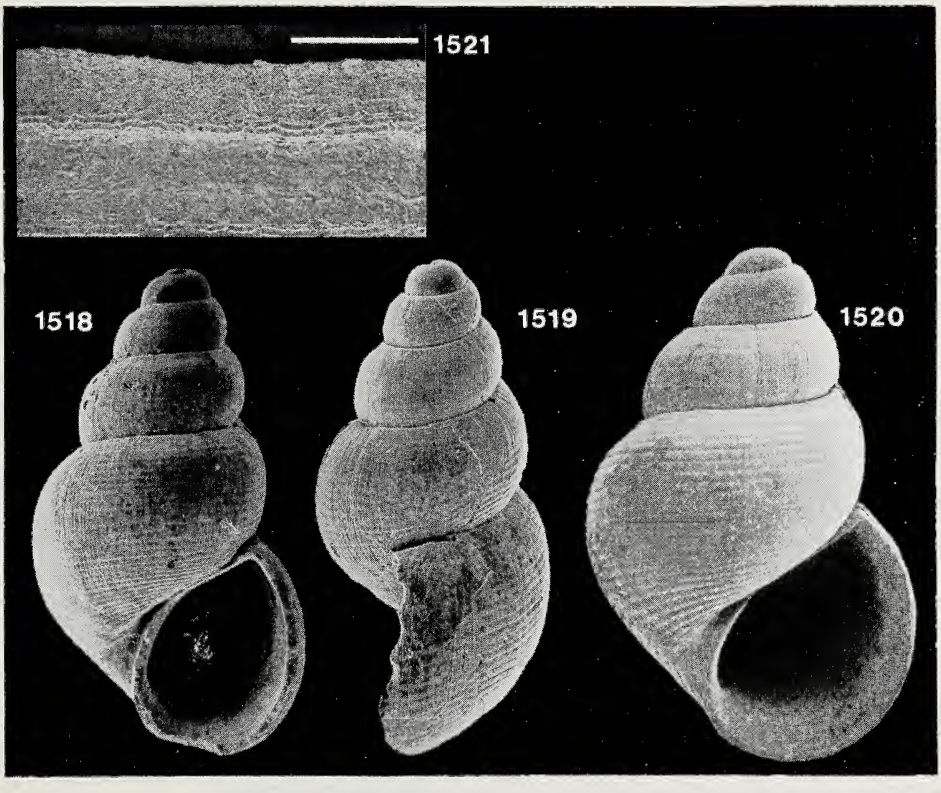
Type locality: Between Sardinia and Corsica, 200-220 m.

Material examined: --PORCUPINE Exp 1870, Coast of Algeria, 93 m, 1 sh (Sykes collection, BMNH); Sardinia, off Capo Comino, 200-250 m, 1 sh, coll. Taviani.

Distribution: Known only from the western Mediterranean.

Remarks: The sculpture of *O. gianninii* (Fig. 1520-1) consists of rounded spiral ribs of equal breadth and with about 3-4 much smaller furrows in the interspaces. *Alvania wareni* (Fig. 1475) is a very similar species from off western Portugal and the Bay of Biscay. It differs in having a more evenly dome-shaped protoconch (Fig. 1462) of 1.2 whorls and a diameter of 460 μm (1.5 whorls and 460 μm in *gianninii*), and in having a less uniform and coarser spiral sculpture. They may prove to be conspecific, when material becomes known from the intermediate area.

Oliverio (1988) figured the radula of a specimen from off Capraia, 400 m and concluded that it belongs to *Onoba*. Terreni (1981, 1983) discussed the nomenclature and figured it from off Capraia and Elba.



Figures 1518-1521. *Onoba gianninii*. **1518-1519**, paratype, 2.2 mm. **1520-1521**, off Capo Comino, 1.7 mm, and microsculpture, scale line 50 μm.

Genus *FRIGIDOALVANIA* Warén, 1974

Frigidoalvania Warén, 1974:125. Type species, by original designation, *Rissoa janmayeni* Friele, 1878. Arctic.

Remarks: Warén (1974) distinguished the two east American species *F. brychia* (Verrill, 1884) and *F. americana* (Friele, 1886), mainly basing the decision on a large sample of each from the same USFC station, where the two occurred sympatrically. Later examination of material in USNM showed that the sample had been sorted, evidently by P. Bartsch and all typical specimens of the two forms had been separated. The majority of the specimens, however, had been left in a third, unnamed sample which contained all intermediate specimens.

Frigidoalvania thalassae sp.n. Figs 1522-1524, 1526

Type material: Holotype and 8 paratypes in MNHN.

Type locality: THALASSA st X340, 44°07' N, 04°30' W, 885 m, Bay of Biscay.

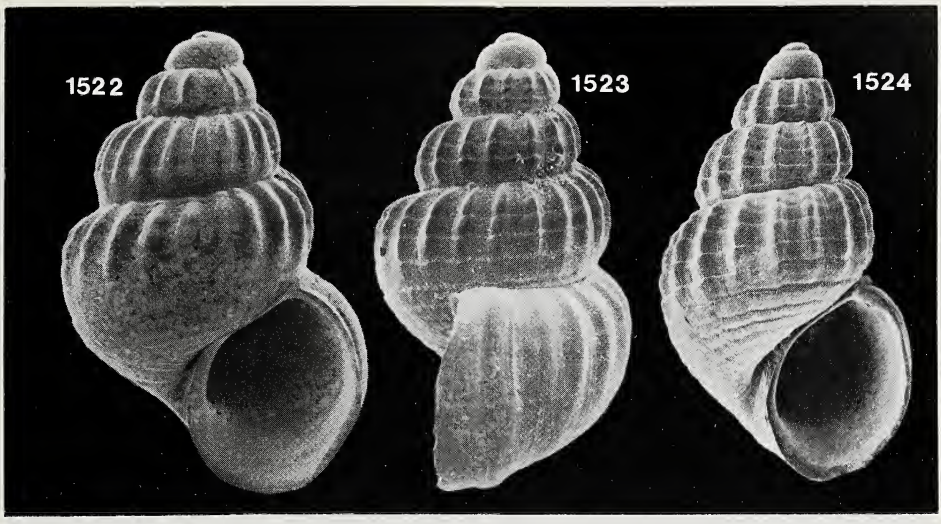
Material examined: The types and --THALASSA st W368, 43°40' N, 03°36' W, 400-137 m, 1 sh; st X305, 44°05' N, 05°00' W, 463 m, 13 spms; st X341, 44°07' N, 04°30' W, 820 m, 4 spms; st X342, 44°08' N, 04°36' W, 700 m, 5 shs; st X343, 44°07' N, 04°39' W, 630 m, 3 shs; st X347, 44°07' N, 04°44' W, 835 m, 2 spms; st X349, 44°07' N, 04°44' W, 590 m, 1 sh; st X362, 44°07' N, 04°51' W, 590 m, 3 spms; st X363, 44°06' N, 04°54' W, 590 m, 6 spms; st Z437, 48°35' N, 10°24' W, 610 m, 1 sh; MONACO Exp st 66, 43°13' N, 09°33' W, 363-510 m, 2 shs (MNHN).

Distribution: Only known from the continental slope of the Celtic Sea southwards to northern Spain, in about 360-850 m.

Description: Shell (Figs 1522-4) of medium-size, opaque, fairly solid, with a large aperture, rounded axial ribs and a blunt apex. Larval shell (Fig. 1526) of 1.6 whorls, sculptured by broad furrows with uneven bottom. Diameter 550 μm. Teleoconch with 3.2 whorls, sculptured by broad, rounded, straight axial ribs, 21 on the body-whorl, of which the last one is larger and thicker and forms a labial varix shortly before the thin edge of the outer lip. The ribs become lower towards the suture and fade out before reaching it. There are also 4-6 impressed spiral lines on the penultimate whorl and five additional lines on the basal area of the body-whorl. These lines vary in strength between individuals and they are often less conspicuous when crossing the axial ribs. The aperture is evenly rounded, with a distinct parietal callus and a narrow chink behind the inner lip.
Dimensions. Height of holotype 2.98 mm, breadth 1.88 mm.
Etymology: Named after R.V. THALASSA.

Remarks: We are not aware of any species which can be easily confused with *F. thalassae*. The softly rounded ribs and sculpture of the protoconch resemble the sculpture of the protoconch of northwest Atlantic *F. pelagica* (Stimpson, 1851), but that species has a distinctly prosocline aperture with thickened outer lip and no enlarged rib just behind the peristome.

We have classified both these species in *Frigidoalvania*, although Ponder (1985a) classified *Rissoa pelagica* in *Onoba*. Our decision is only based on similarity in protoconch and teleoconch morphology, but we consider the unusually thick, brownish periostracum a synapomorphy.



Figures 1522-1524. *Frigidoalvania thalassae*. **1522-1523**, THALASSA st X340, 2.8 and 3.0 mm (1523, holotype). **1524**, MONACO Exp st 66, 3.0 mm.

Genus *CRISILLA* Monterosato, 1917

Crisilla Monterosato, 1917:12. Type species, by monotypy, *Turbo semistriatus* Montagu, 1808 (See Figs 1534-1535). Europe.

Remarks: We have used *Crisilla* as a genus while Ponder (1985a) regarded it as a subgenus of *Alvania*. The species here classified in *Crisilla* all have a similar shape of the shell and usually a semi-transparent shell with brownish, square blotches. One unusual feature shared by the species here classified in *Crisilla*, is the pair of subsutural furrows, also present in *Alvania zylensis* Gofas & Warén, 1982. That species we believe to belong here also.

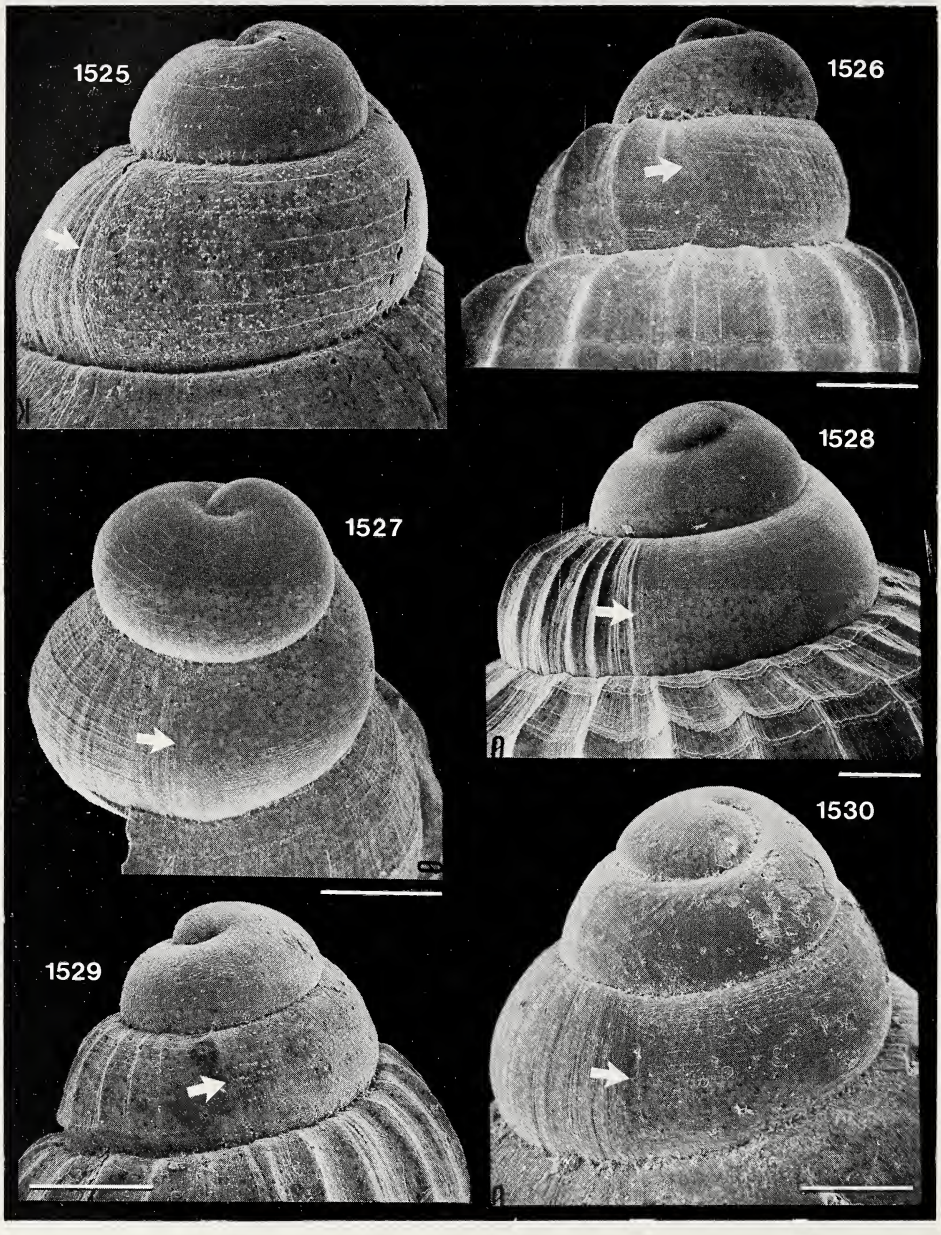
Our main reason for raising *Crisilla* to generic level is not based on a phylogenetic comparison with all groups of *Alvania*, it is more that we want to emphasize the homogenity of this little group, compared to the broad spectrum of radiations within *Alvania*.

Crisilla amphiglypha sp.n. Figs 1531-1532, 1536-1537

Type material: Holotype (not figured) in RMNH, 1 paratype in MNHN.

Type locality: CANCAP st 2.079, 28°01' N, 14°26' W, 870 m.

Material examined: The types and --DISCOVERY st 7984, 25°26' N, 16°10' W, 811-890 m, 2 shs; CANCAP st 2.058, 27°58' N, 13°15' W, 500 m, 5 shs; st 2.085, 28°02' N, 14°30' W, 600 m, 4 shs; --SEAMOUNT 1 st CP99, 35°04' N, 12°55' W, 225-280 m, 1 sh.



Figures 1525-1530. Protoconchs of Rissoidae. **1525,** *Onoba gianninii*, paratype. **1526**, *Frigidoalvania thalassae*, THALASSA st X340. **1527,** *Onoba leptalea*, J. Brönlunds Fjord, NE Greenland. **1528**, *Alvania wyvillethomsoni*, INGOLF st 103. **1529**, *Alvania adiaphoros*, MONACO Exp st 2214. **1530,** *Pseudosetia semipellucida*, NORBI st CP10.

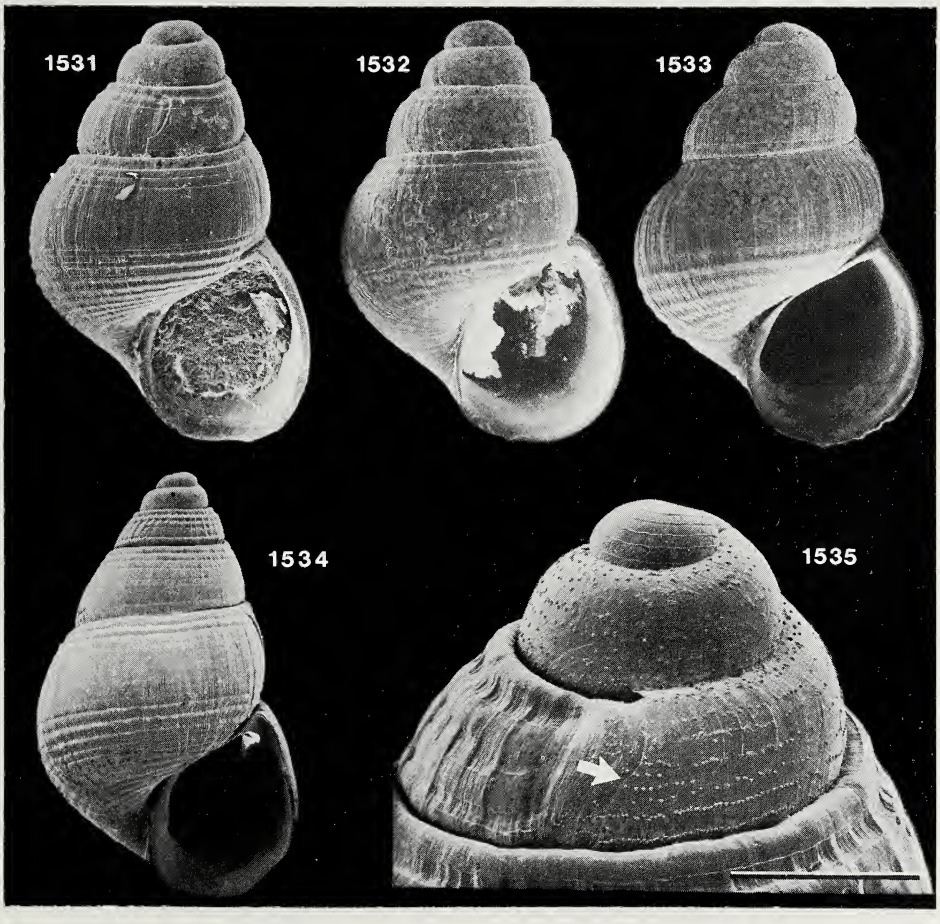
Scale lines 200 μm.

The arrows indicate the protoconch - teleoconch demarcation.

Distribution: The Canaries and off southern Morocco, in about 500-900 m.

Description: Shell (Figs 1531-2) small, conical, fairly solid, colourless transparent, mainly with spiral sculpture at the suture and base, with a large aperture and blunt apex. Larval shell (Figs 1536-7) depressed, dome-shaped, consisting of 1.5 weakly and evenly convex whorls, sculptured with a few scattered very small tubercles. Diameter 500 μm. Teleoconch with 2.2-2.3 rather flat whorls of rapidly increasing diameter, sculptured with numerous, irregularly disposed incremental lines of varying strength and 1-3 canal-like furrows just below the suture and 5-8 additional, similar furrows at and below the level of the suture on the body-whorl, covering most of the basal area, but leaving the area close to the umbilical chink smooth. Aperture large, slightly expanded, somewhat squarish. Outer lip slightly thickened, inner lip reflected over an inconspicuous umbilical crevice. Dimensions. Height of holotype 1.86 mm, breadth 1.28 mm.

Etymology: Amphi (Greek) on both sides, *glyphein* (Greek) engrave.



Figures 1531-1535. Genera *Gofasia* and *Crisilla*. **1531,** *C. amphiglypha*, DISCOVERY st 7984, 2.1 mm. **1532,** *C. amphiglypha*, CANCAP st 2.058, 1.8 mm. **1533,** *G. vanderlandi*, SEAMOUNT st CP99, 1.2 mm. **1534-1535,** *C. semistriata*, Sagres, southern Portugal, 2.2 mm, and protoconch, scale line 200 μm. The arrow indicates the protoconch - teleoconch demarcation.

Remarks: The shells from the DISCOVERY were taken at the West African coast while those from CANCAP originate from the Canaries, some distance off the coast, and there is a difference between them, the sculpture of the larval shell being much denser in the shells taken by the DISCOVERY. We cannot, however, consider the present material sufficient for any distinction of the two populations.

Crisilla amphiglypha resembles *Gofasia vanderlandi* (Figs 1533, 1542-4) in the shape of the shell, but that species lacks the conspicuous spiral lines below the suture and has a highly distinctive character in the pores which form its microscopic spiral sculpture.

Genus *GOFASIA* gen. n.

Type species: Gofasia galiciae sp.n.

Diagnosis: Medium-sized to small rissoids with axial and/or spiral ribs and a micro-sculpture of small pores aligned to form indistinct spiral lines. Protoconch with minute granulae.

Etymology: Named after our colleague and friend Dr Serge Gofas, with whom we collected this new genus and species during the SEAMOUNT cruise in 1987.

Remarks: We have reluctantly introduced this new generic name for three species, which from the similarity of the micro-sculpture, seem closely related. They do not fit into any described genus. The nearest we can come is *Crisilla*, but the species of *Crisilla* have no trace of the peculiar microsculpture.

We have seen additional, undescribed species from the seamounts off Portugal in more shallow water.

Gofasia vanderlandi sp.n. Figs 1533, 1540-1544

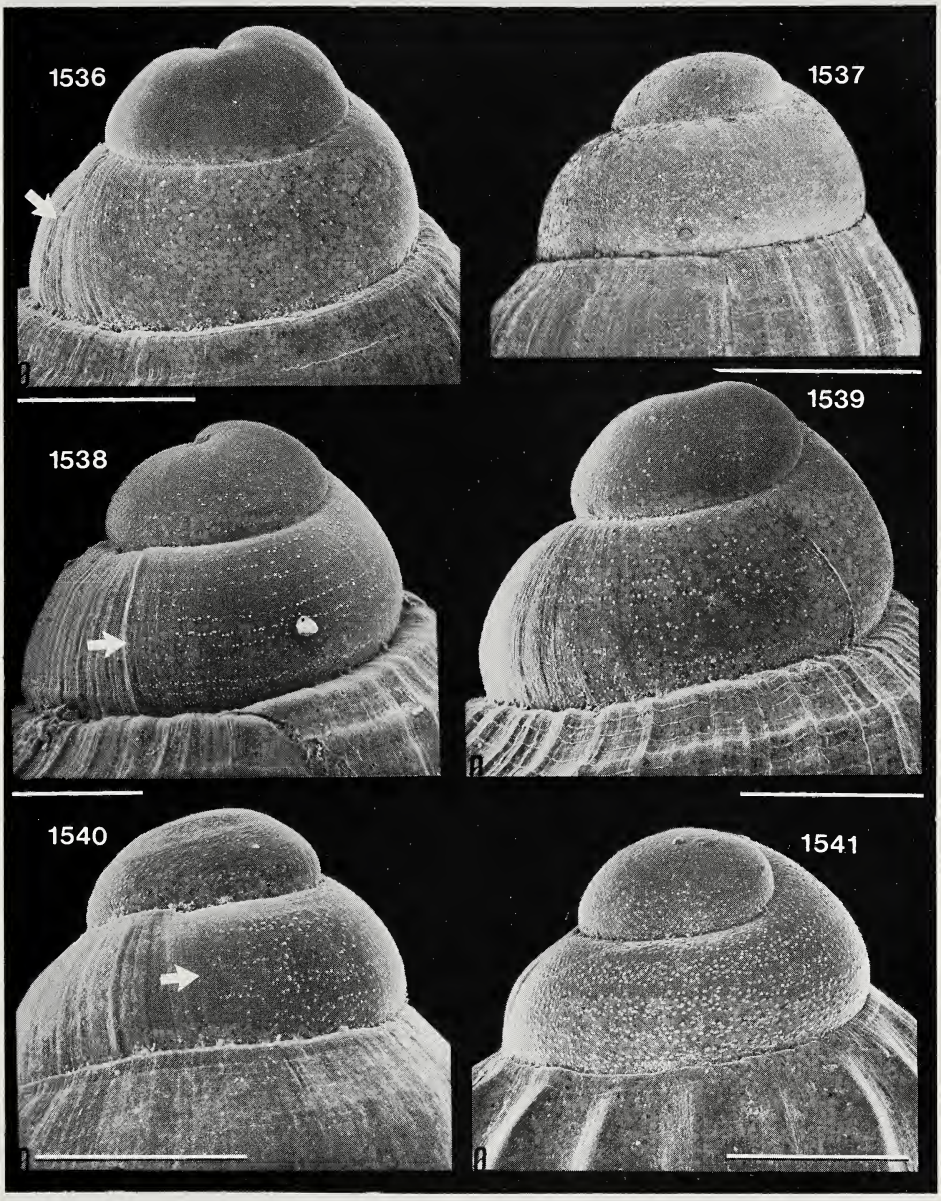
Type material: Holotype in RMNH, 12 paratypes in RMNH and MNHN.

Type locality: CANCAP st 3.068, 30°07' N, 15°53' W, 310 m, the Canaries.

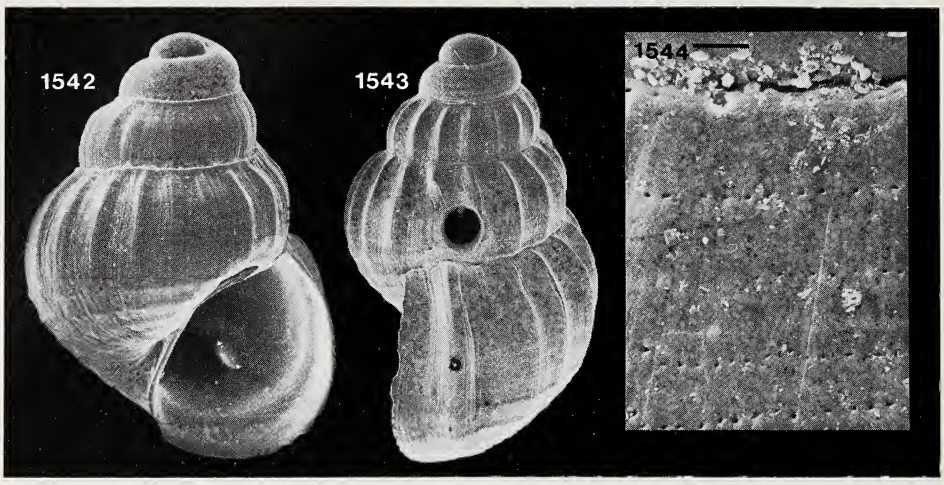
Material examined: The types and SEAMOUNT st DE98, 35°03' N, 12°55' W, 300-325 m, 10 shs; st CP99, 35°04' N, 12°55' W, 225-280 m, 5 spms; --CANCAP st 3.071, 30°07' N, 15°54' W, 748 m, 5 shs; st 3.102, 30°07' N, 15°53' W, 600 m, 11 shs.

Distribution: Only known from the material examined, from off southwestern Portugal to north of the Canaries, in about 300-750 m.

Description: Shell (Figs 1533, 1542-3) small, conical, transparent, fairly solid, with a big aperture and blunt apex. Larval shell (Figs 1540-1) depressed, with 1.4 convex whorls, sculptured by numerous small tubercles, more or less distinctly arranged in bands. Diameter 380 μm. Teleoconch of 2.6 whorls of rather rapidly increasing diameter, sculptured by softly rounded axial ribs of varying strength, in some specimens totally absent. Incremental lines narrow and irregular. The spiral sculpture, of very fine lines, actually consists of somewhat irregularly and spirally arranged very small pores (Fig. 1544). There are also 4-5 broad, low ribs on the basal area. Aperture rounded with a thickened varix slightly behind the sharp outer lip. Parietal callus distinct. Inner lip reflected over a narrow or closed umbilical chink.



Figures 1536-1541. Protoconchs of Rissoidae. **1536,** *Crisilla amphiglypha*, CANCAP st 2.079. **1537,** *G. vanderlandi*, SEAMOUNT st CP99. **1538-1539,** *Alvania dipacoi*, CANCAP st 2.058. **1540,** *Gofasia vanderlandi*, CANCAP st 3.068. **1541,** *G. vanderlandi*, CANCAP st 3.071.
The arrows indicate the protoconch - teleoconch demarcation.
All scale lines 200 μm.



Figures 1542-1544. *Gofasia vanderlandi*. **1542**, CANCAP st 3.068, 1.4 mm. **1543-1544**, CANCAP st 3.071, 1.8 mm and microsculpture, scale line 10 μm.

Dimensions. Height of holotype 1.68 mm, breadth, 1.09 mm.
Etymology: Named after Prof. J. van der Land (RMNH), project leader of the biological part of the CANCAP program.

Remarks: Gofasia vanderlandi resembles *G. galiciae* (Figs 1545-50), *G. josephinae* (Figs 1555-62) and an undescribed species from more shallow water on the seamounts off southwestern Portugal, in the strange construction of the spiral sculpture. *Rissoa quisquiliarum* Watson (see appendix and Gofas 1990:103), from the Azores, has a taller shell, lacks the pores, and has a proportionally smaller larval shell.

Gofasia galiciae sp.n. Figs 1545-1552

Type material: Holotype in MNHN, numerous paratypes in SMNH 4355, MNHN.

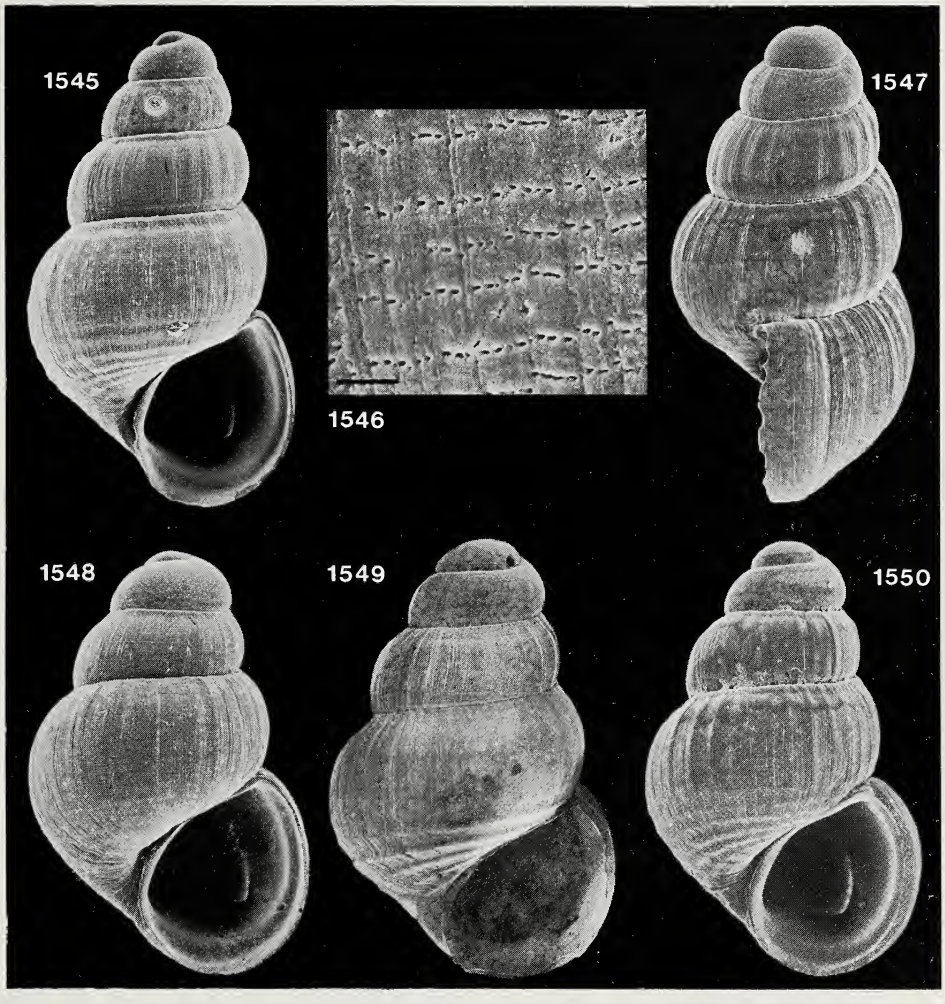
Type locality: SEAMOUNT st DW116, 42°52' N, 11°51' W, 985-1000 m, Galicia Bank.

Material examined: The types and --SEAMOUNT st DE48, 36°48' N, 14°32' W, 1350-1360 m, 3 shs; st CP50, 36°47' N, 14°32' W, 1360-1380 m, 9 shs; st DW106, 42°42' N, 11°49' W, 765 m, 1 sh; st DW108, 42°51' N, 11°53' W, 1110-1125 m, 268 spms; st DW111, 42°40' N, 11°36' W, 675-685 m, 120 spms; st CP117, 42°43' N, 11°45' W, 770 m, 1 sh.

Distribution: Only known from the material examined from the Galicia Bank and Josephine Seamount, in 700-1400 m.

Description: Shell (Figs 1545-50) tall, slender, cylindrical, colourless transparent, with indistinct axial and a few more distinct, basal spiral ribs. Larval shell (Figs 1551-2) of 1.5 depressed, dome-

shaped whorls, sculptured with sparse small tubercles, occasionally drawn out and fused to short streaks, especially towards the teleoconch. Diameter 370 μm. Holotype with 3.0 distinctly convex whorls, with low, rounded, indistinct, sometimes totally absent axial ribs which always disappear before reaching the sutures. There are also 4-7, sometimes very indistinct, low and rounded spiral ribs, confined to the basal area, below the level of the suture. The whole surface is covered by an extremely fine spiral striation, which gives the surface a velvety appearance and consists of spirally arranged, elongated pores (Fig. 1546). The aperture is evenly rounded, with a thick varix shortly behind the sharp and thin, orthocline outer lip. The inner lip is reflected over a distinct umbilical crevice.

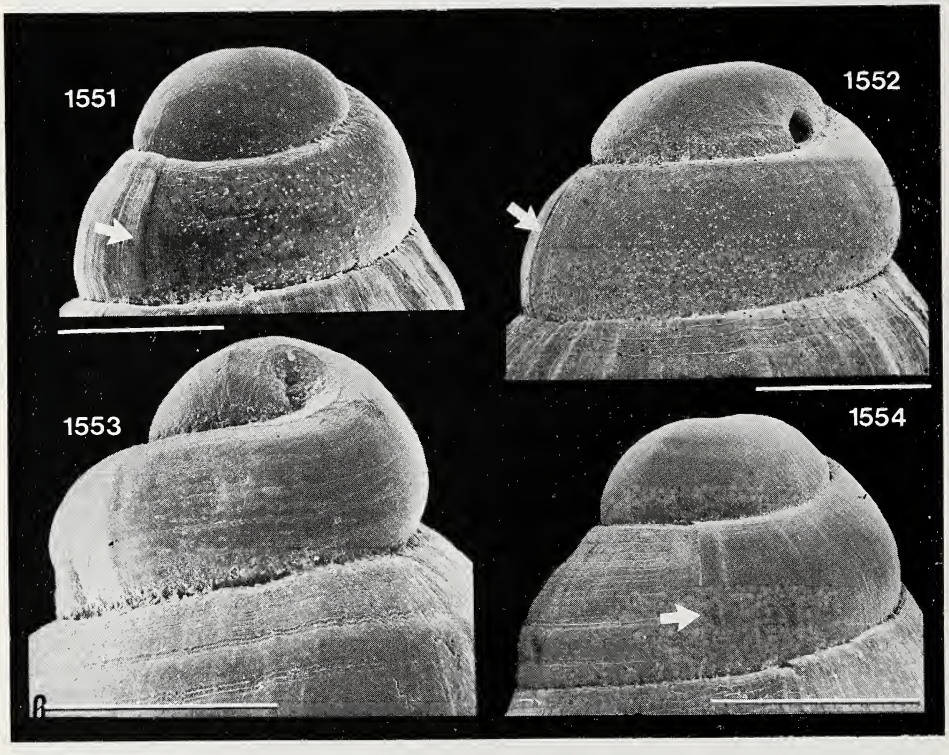


Figures 1545-1550. *Gofasia galiciae*. **1545**, holotype, 1.6 mm. **1546**, SEAMOUNT st DW116, microsculpture, scale line 10 μm. **1547-1548**, SEAMOUNT st DW116, 1.6 mm and 1.2 mm. **1549**, SEAMOUNT st DE48, 1.6 mm. **1550**, SEAMOUNT st DW116, 1.3 mm.

Dimensions. Height of the holotype 1.64 mm, breadth 0.97 mm. Maximum height 1.8 mm.
Etymology: Named after the Galicia Bank, off northwestern Spain.

Remarks: Gofasia galiciae shows some conchological resemblance to several species of *Alvania* related to *A. subsoluta* and to *Onoba*. Such features are the shape of the shell, the evenly convex whorls and the rounded aperture, which however is orthocline, not opisthocline as in those species of *Alvania* and *Onoba*.

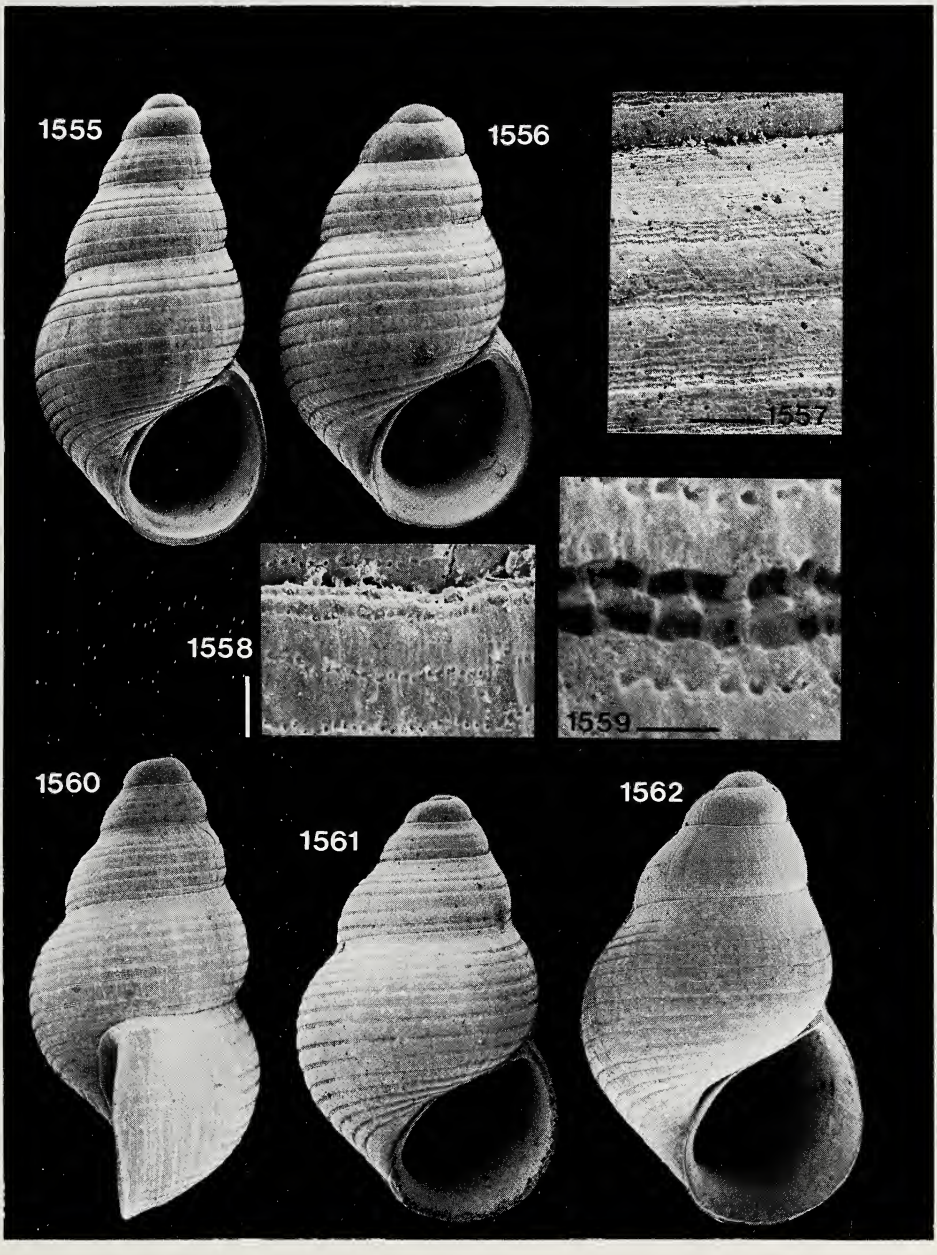
A closely related, undescribed species occurs on the seamounts off southwestern Portugal, in more shallow water. It differs by having a more fragile shell without axial ribs and the microtubercles on the protoconch are about 3-4 times larger.



Figures 1551-1554. Protoconchs of Rissoidae. **1551-1552**, *Gofasia galiciae*, SEAMOUNT st DW116. **1553,** *Manzonia vigoensis*, Vigo Bay, NW Spain. **1554,** *Gofasia josephinae*, SEAMOUNT st DW16.

The arrows indicate the protoconch - teleoconch demarcation.

Scale lines 200 μm.



Figures 1555-1562. *Gofasia josephinae*. **1555-1556**, SEAMOUNT st DW05, 2.1 and 1.5 mm. **1557-1559**, SEAMOUNT st DW17, microsculpture, scale lines 50 μm, 10 μm and 5 μm respectively. **1560**, SEAMOUNT st DW16, 2.0 mm. **1561**, holotype, SEAMOUNT st DW61, 2.0 mm. **1562**, SEAMOUNT st DW92, 1.6 mm.

Gofasia josephinae sp.n. Figs 1554-1562

Type material: Holotype SMNH 4356, 180 paratypes in MNHN and SMNH 4357.

Type locality: SEAMOUNT st DW61, 36°40' N, 14°16' W, 200-205 m, Josephine Bank, off southwestern Portugal.

Material examined: Off southwestern Portugal, SEAMOUNT st DW04, 36°33' N, 11°34' W, 93-96 m, 47 shs; st DW05, 36°02' N, 11°38' W, 180 m, 370 spms; st DW06, 36°20' N, 11°38' W, 250 m, 165 shs; st DW08, 36°29' N, 11°37' W, 470-485 m, 15 shs; st DE09, 36°32' N, 11°38' W, 350-360 m, 46 shs; st DE10, 36°27' N, 11°35' W, 500-545 m, 2 shs; st CP12, 36°24' N, 11°43' W, 1005-1040 m, 1 sh; st DW15, 36°33.4' N, 11°28.8' W, 300-330 m, 8 shs; st DW16, 36°33' N, 11°36' W, 255-265 m, 306 shs; st DW17, 36°30' N, 11°31' W, 155 m, 1 sh; st CP20, 36°34' N, 11°30' W, 305-320 m, 147 spms; st CP30, 36°44' N, 11°23' W, 1940-2075 m, 1 sh; st DW38, 36°42' N, 14°17' W, 235-245 m, 70 shs; st DE39, 36°40' N, 14°16' W, 207-222 m, 41 shs; st DW41, 36°40' N, 14°15' W, 200 m, 3 shs; st DW43, 36°46' N, 14°18' W, 315-335 m, 44 shs; st DW45, 36°46' N, 14°18' W, 315-335 m, 1 sh; st DW58, 36°46' N, 14°20' W, 340-380 m, 2 shs; st DW60, 36°43' N, 14°17' W, 240-255 m, 3 shs; st DW92, 35°03' N, 12°54' W, 117-129 m, 692 pms; st DE95, 36°05' N, 12°55' W, 197-210 m, 300 spms; st DE98, 35°03' N, 12°55' W, 300-325 m, 1671 spms; st CP99, 35°04' N, 12°55' W, 225-280 m, 23 shs; JOSEPHINE Exp, Josephine Bank, 626-740 m, 1 sh (SMNH).

Distribution: Only known from the material examined from Ampère, Gorringe and Josephine seamounts, usually in 100-1000 m.

Description: Shell small (Figs 1555-62), conical, transparent, fairly solid. Larval shell (Fig. 1554) low and dome-shaped, consisting of about 1.2 whorls, diameter 360 μm, perfectly smooth. Holotype with 3.1 whorls, adapical part, between suture and periphery, flattened, almost concave; abapical part strongly convex. Suture shallow, not very distinct. Sculpture consists of sharp, shallow, incised spiral furrows, 2-4 on first teleoconch whorl, up to 16 on body-whorl. Micro sculpture (Figs 1557-9) of numerous lines of even strength, covering all surface, barely visible with stereomicroscope, rows of very small pores. Axial sculpture only incremental lines. Aperture large, orthocline with thickened outer lip but lacking distinct varix.
Dimensions. Height of the shell 2.00 mm, breadth 1.18 mm, height of aperture 0.80 mm, width 0.64 mm.

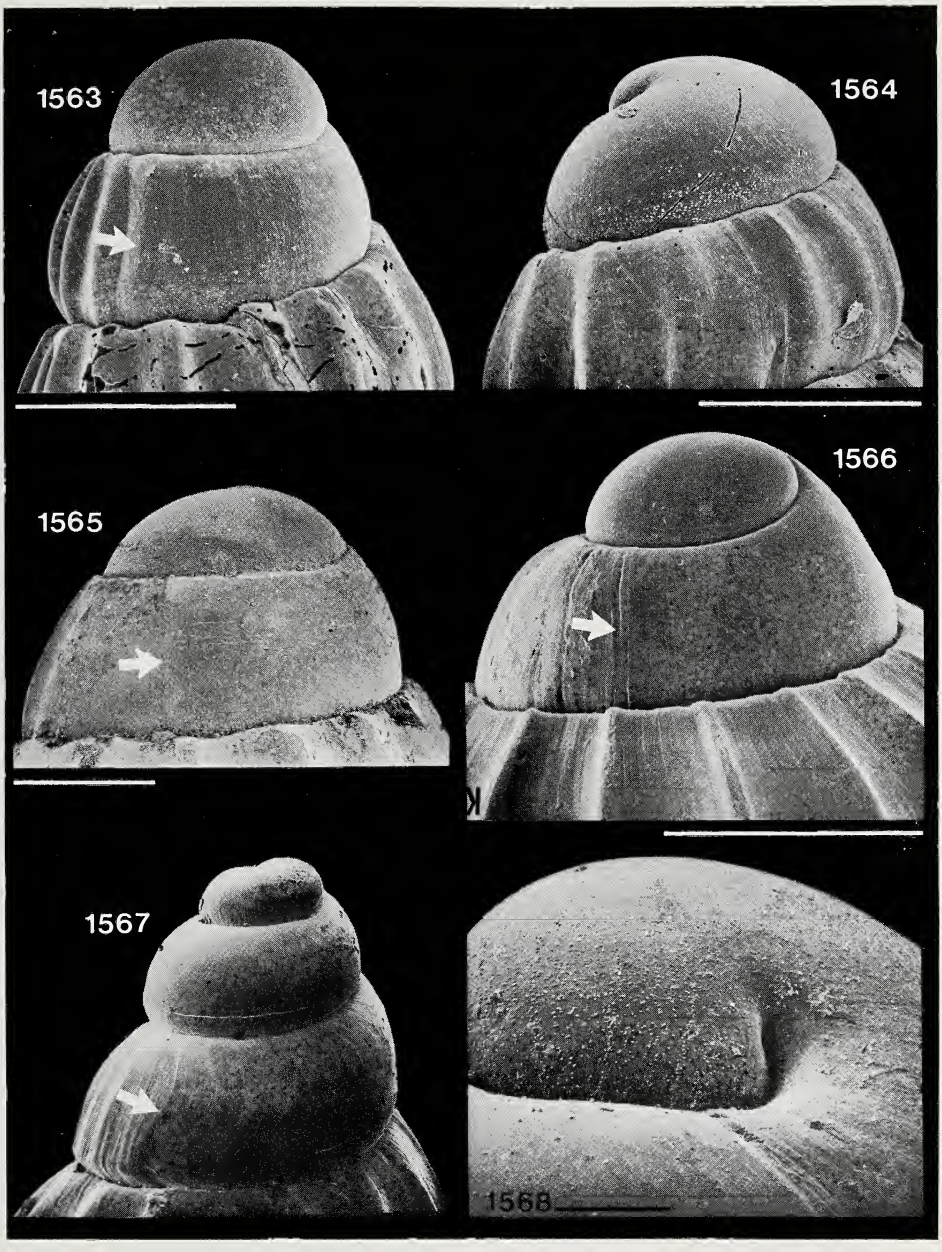
Etymology: Named after the Josephine Bank, itself named by the Swedish JOSEPHINE Expedition which discovered it in 1869.

Remarks: Gofasia josephinae is highly variable in the height of the shell and in the presence of scattered, sharply and deeply incised spiral lines (Fig. 1557). The large material examined, however, has convinced us that only a single species is involved.
A very characteristic feature is the shape of the whorls with a concave area below the suture.

Genus *PUSILLINA* Monterosato, 1884

Pusillina Monterosato, 1884:56. Type species, by monotypy, *Rissoa pusilla* Philippi, 1836 (not Grateloup, 1828) (= *Rissoa philippii* Aradas & Maggiore, 1844, Figs 1568, 1579). Mediterranean.

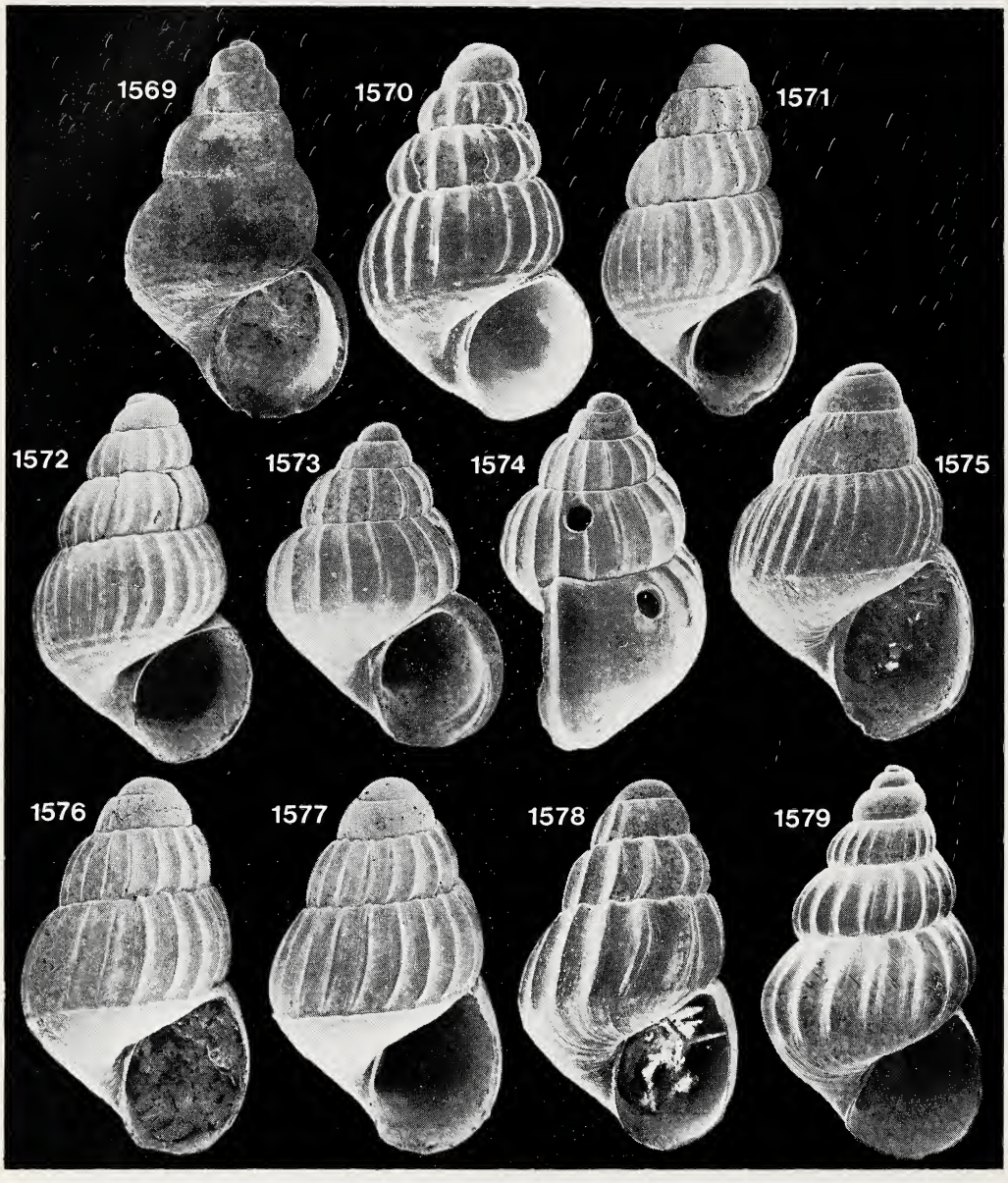
Remarks: Most species of *Pusillina* occur in shallow water, but for instance *P. inconspicua* (Alder, 1844) is regularly found down to more than one hundred meters depth. We have therefore included



Figures 1563-1568. Protoconchs of *Pusillina*. **1563**, *P. amblia*, MONACO Exp st 213. **1564**, *P. amblia*, MONACO Exp st 216. **1565**, *P. metivieri*, CANCAP st 4.060. **1566**, *P. hadra*, holotype. **1567-1568**, *P. philippii*, Calvi, Corsica.

Scale lines 200 μm (1563-1567) and 20 μm (1568).

The arrows indicate the protoconch - teleoconch demarcation.



Figures 1569-1579. Genus *Pusillina*. **1569**, *Rissoa (Setia) quisquiliarum*, holotype, 1.6 mm. **1570**, *P. amblia*, syntype, 2.3 mm. **1571-1572**, *P. amblia*, MONACO Exp, both 2.1 mm. **1573-1574**, *P. hadra*, holotype, 1.9 mm. **1575**, *P. metivieri*, PORCUPINE Exp 1870, off Cape Sagres, Portugal, 83-107 m, 1.5 mm. **1576**, *P. metivieri*, holotype, 1.9 mm. **1577-1578**, *P. metivieri*, CANCAP st 4.060, 1.9 mm and 2.6 mm. **1579**, *P. philippii*, Calvi, Corsica, 1.8 mm.

P. metivieri, P. hadra and *P. amblia* in *Pusillina*, despite that they live unusually deep for the genus. Conchologically these species resemble *R. philippii*, although the protoconch is different due to the shallow-water species *R. philippii* having planktotrophic, and the other species lecithotrophic development.

Pusillina hadra sp.n. Figs 1566, 1573-1574

Type material: Holotype in MNHN.

Type locality: SEABED 2 st KG38, 19°17' N, 29°47' W, 4975m.

Material examined: The holotype.

Distribution: Only known from the type locality, Cape Verde Basin.

Description: Shell (Figs 1573-4) small, whitish semitransparent, fairly solid, with inflated whorls. Protoconch (Fig. 1566) perfectly smooth, depressed dome-shaped, diameter 350 μm and consisting of 1.15 whorls. Teleoconch with 3.0 whorls, sculptured by rounded ribs which gradually become lower towards the sutures, 14 on the last whorl, weaker towards the aperture and leave the last 1/10 of a whorl and the area below the periphery smooth. No secondary sculpture. Aperture about as high as broad, with a solid parietal callus. Outer lip thickened. Inner lip reflected over the umbilical area, partly concealing a broad and shallow umbilical crevice, which is encircled by a blunt and indistinct basal keel.
Dimensions. Height 1.88 mm, breadth 1.52 mm, minimum diameter of body-whorl 1.22 mm.
Etymology: Hadra (Greek) - stout, refers to the shape of the shell.

Remarks: The holotype is an empty shell, drilled by a naticid (?), but in perfect condition and very fresh-looking.

Pusillina amblia (Watson, 1886) Figs 1563-1564, 1570-1572

Rissoa amblia Watson, 1886:590, pl. 44 fig. 8.
Rissoa (Turbella) amblia: Dautzenberg 1927:126.

Type material: Syntypes BMNH 1887.2.9.1897-1900.

*Type locality:*CHALLENGER Exp st 85, 28°42' N, 18°06' W, 2047 m.

Material examined: The types and --BALGIM st CP68, 35°12' N, 07°53' W, 2040 m, 14 spms; CINECA st B31, 29°36' N, 11°04' W, 1500 m, 1 sh; MONACO Exp st 1116, 31°42' N, 10°47' W, 2165 m, a few shs; st 1713, 28°04' N, 16°50' W, 1530-1340 m, a few shs; --st 2048, 32°33' N, 17°02' W, 1968 m, 121 shs (MNHN, MOM).

Distribution: From off northwestern Morocco, south to the Canaries, in 1500-2200 m.

Remarks: Pusillina amblia resembles *Benthonellania fayalensis* (Figs 1585-8), but is proportionally more slender, with rather broad and indistinct spiral ribs on the basal area, while those of *fayalensis* are undulating, and well defined.

Rissoa amblia var. *inornata* Dautzenberg, 1927 was based on *Benthonella tenella*, see that species.

Pusillina metivieri sp.n. Figs 1565, 1575-1578

Type material: Holotype in RMNH, 11 paratypes in MNHN and RMNH.

Type locality: CANCAP st 4.060, 28°48' N, 13°45' W, 590 m.

*Material examined:*The types and --CANCAP st 2.085, 28°02' N, 14°30' W, 600 m, 1 sh; st 4.086, 28°54' N, 13°33' W, 785 m, 14 shs; PORCUPINE Exp 1870, off Cape Sagres, 87-105 m, 5 shs (coll. Sykes, BMNH).

Distribution: Only known from the material examined, from southwestern Portugal to the Canaries, in 100-800 m.

Description: Shell small (Figs 1575-8), rissoiform, colourless, not very solid, with blunt apex and strong, curved ribs. Larval shell (Fig. 1565) depressed, dome-shaped, consisting of about 1.5 whorls, with a small and poorly defined initial part, sculptured by scattered, very thin and indistinct spiral lines, and of a diameter of 480 μm. Teleoconch of 2.6 whorls, sculptured by evenly curved, rather sharp axial ribs, 15-22 on the body-whorl and continuing to the outer lip. They are abruptly interrupted by a spiral rib, just below the periphery of body whorl. There are also numerous, fine incremental lines, more obvious on the basal area. Aperture simple, without thickened lips. Parietal callus thin. Inner lip reflected over a narrow umbilical crevice.
Dimension. Height of holotype 1.92 mm, breadth 1.20 mm.

Etymology: Named after Bernard Metivier, our old friend and companion of many deep-sea cruises.

Remarks: Pusillina metivieri may be a shallow water species, but we have seen nothing similar to it in the literature and doubt this.
It can be recognized from the distinct, curved axial ribs, almost smooth basal area and the distinct spiral rib encircling the periphery.

Subgenus *VICINIRISSOA* Ponder, 1985

Vicinirissoa Ponder, 1985a:31. Type species, by original designation, *Cingula harpa* Verrill, 1880. Northwest Atlantic.

Remarks: Vicinirissoa was based on the type species solely and we are not aware of any additional species from the northern Atlantic which fits the subgenus.

Pusillina (Vicinirissoa) harpa (Verrill, 1880) Figs 1448, 1580

Rissoa (Cingula) harpa Verrill, 1880b:374; 1882:523, pl. 58 fig. 6.
Cingula harpa: Warén, 1974:125, fig. 3.
Pusillina (Vicinirissoa) harpa: Ponder, 1985a:31, figs 83 A-D.

Type material: Holotype USNM 43693.

Type locality: USFC st 34, 42°37' N, 69°39' W, 291 m.

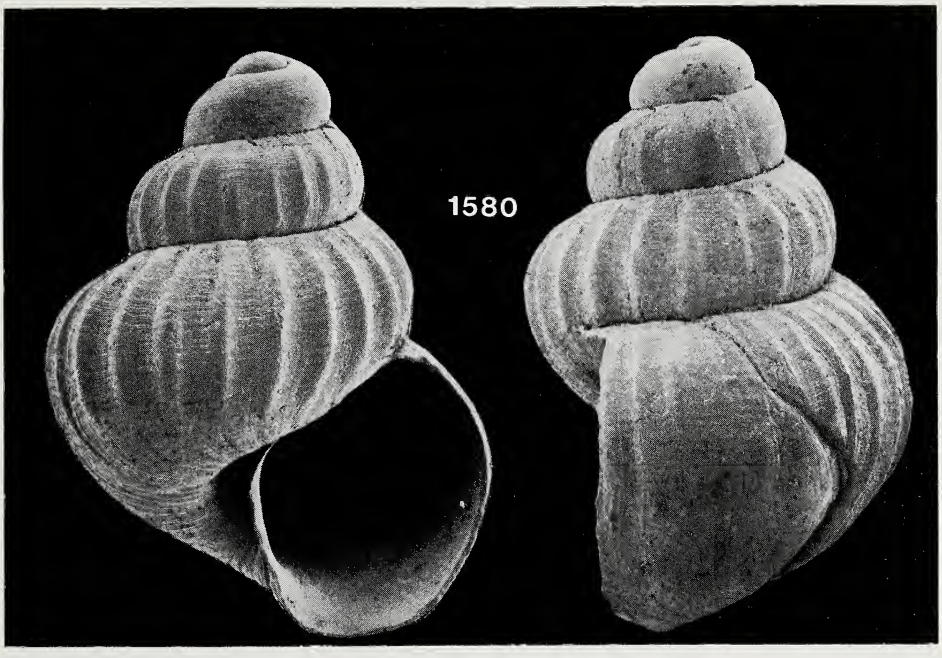


Figure 1580. *Pusillina harpa*, INGEGERD & GLADAN st 42, 49°41' N, 52°09' W, 340 m, 1.9 mm.

Material examined: Listed by Warén (1974:125).

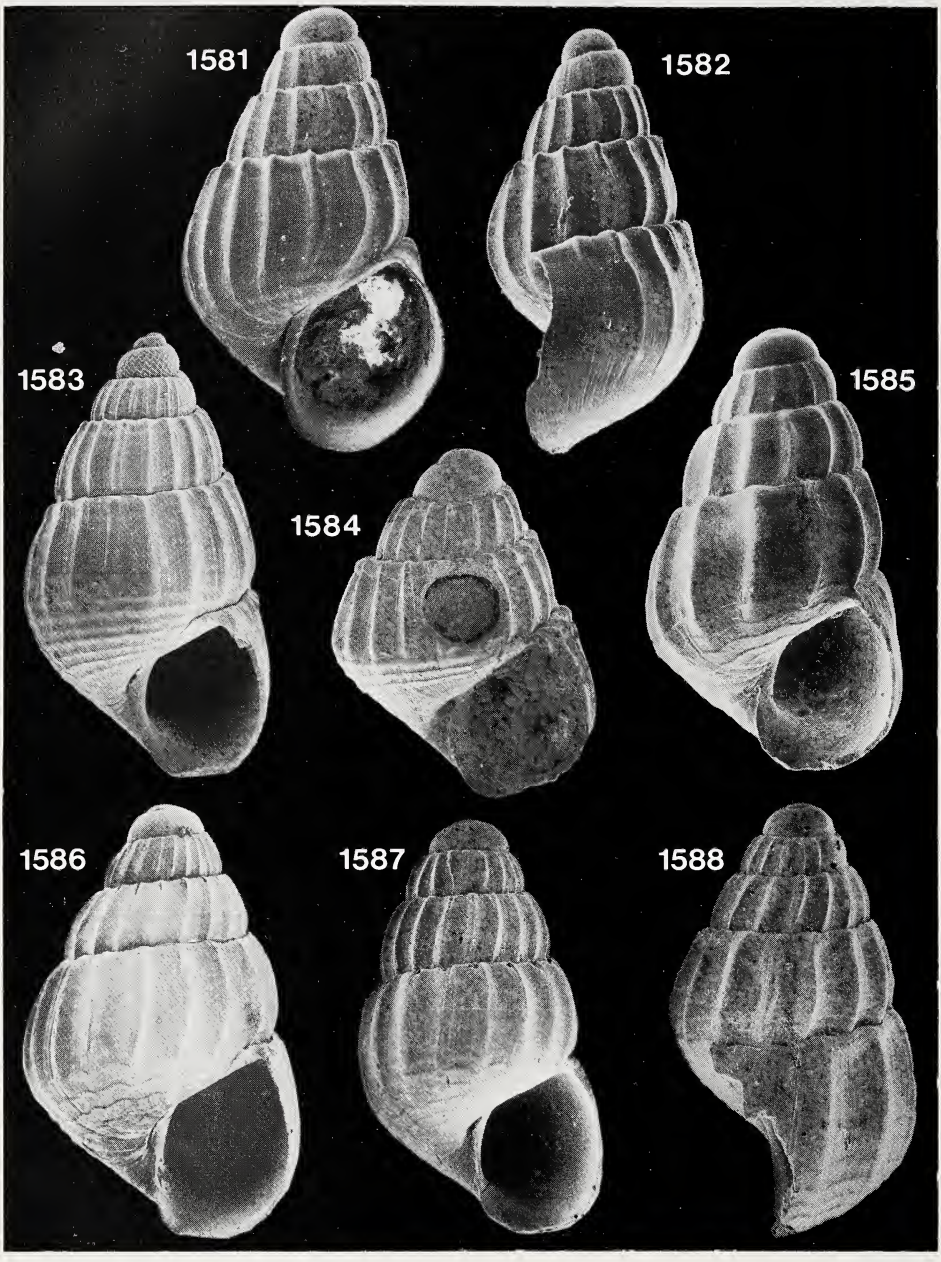
Distribution: From off Newfoundland to off Maine, in about 300-800 m (Rex *et al.* 1988).

Remarks: We have included this extralimital species since we find it likely that it occurs also off western Iceland, like so many other northeast American species. The variation was described by Rex *et al.* (1988).

Genus *BENTHONELLANIA* Lozouet, 1990

Benthonellania Lozouet, 1990:314. Type species, by original designation, *B. gofasi* Lozouet, 1990. West Africa.

Remarks: Benthonellania is a group of rissoid species ocurring in temperate and tropical areas, on the continental shelf and upper slope. The distinctions from *Benthonella* are not clear-cut. Ponder (1985a, fig. 119F) figured an undescribed species combining a typical *Benthonella* larval shell and *Benthonellania* teleoconch.



Figures 1581-1588. Genus *Benthonellania*. **1581-1582**, *B. oligostigma*, holotype, 2.0 mm. **1583**, *B. gofasi*, MONACO Exp st 1116, 2.3 mm. **1584**, *B. agastachys*, holotype, 1.8 mm. **1585**, *B. fayalensis*, holotype, 1.6 mm. **1586-1588**, *B. fayalensis*, MONACO Exp st 233, 1.8 mm, 2.0 mm and 2.2 mm respectively.

Benthonellania gofasi Lozouet, 1990 Figs 1583, 1589-1590

Benthonellania gofasi Lozouet, 1990:322, figs 1-4, 8-9, 20-23.

Type material: Holotype in MNHN, 20 paratypes in MNHN, 2 in AMS.

Type locality: Southwest of Cap Manuel, off Dakar, Senegal, 250 m.

Material examined: The types and: --MONACO Exp st 1116, 31°44' N, 10°47' W, 2165 m, 1 sh; DISCOVERY st 8014, 20°44' N, 17°46' W, 550-595 m, 3 shs.

Distribution: From Madeira to Angola, in 80-2200 m (Lozouet 1990).

Remarks: Good specimens of *Benthonellania gofasi* can easily be recognized by the very distinct zigzag sculpture of protoconch II (Fig.1589-90).

Benthonellania fayalensis (Watson, 1886) Figs 1585-1588, 1591

Rissoa fayalensis Watson, 1886:589, pl. 44 fig. 7.
Rissoa fayalensis: Dautzenberg & Fischer 1906:46.

Type material: Holotype BMNH 1897.2.9.1896.

Type locality: CHALLENGER Exp st 75, 38°38' N, 28°28.5' W, 819-910 m, off Fayal, Azores.

Material examined: The types and --SEAMOUNT st DW63, 35°15' N, 15°35' W, 630 m, 2 shs; MONACO Exp st 233, 38°33' N, 28°09' W, 1300 m, 36 shs (MNHN, MOM).

Distribution: The Azores. It is uncertain if it reaches the seamounts off southwestern Portugal (see Remarks).

Remarks: The two shells from SEAMOUNT st DW63 are old and broken, but not very worn and agree well with specimens from MONACO Exp st 233. Some of the lots recorded by Dautzenberg (1927) could not be found and some were erroneously identified, and it is mainly station 233 and the type locality which remain as acceptable records. For differences from *B. amblia*, see that species.

Benthonellania oligostigma sp.n. Figs 1581-1582, 1594

Type material: Holotype and one paratype in MNHN.

Type locality: J. CHARCOT Madere st 19, 32°59' N, 16°26' W, 990 m, SW of Porto Santo, Madeira.

Material examined: The type material.

Distribution: Only known from the type locality, northeast of Madeira in 990 m.

Description: Shell (Figs 1581-2) small, fairly solid, conical, with strong ribs ending abruptly at the upper suture. Larval shell (Fig. 1594) colourless, consisting of 1.2 depressed whorls, with scattered

microscopic granules, to some extent arranged in spiral bands. Diameter 430 μm. Teleoconch with 3.1 whorls of slowly increasing height, separated by deep suture. Body-whorl with 15 strong, slightly curved axial ribs, most prominent at upper suture where giving whorls a coronated appearence, at lower suture partly concealed by subsequent whorl, fading out on basal surface. Basal surface with 4-5 very low, indistinct spiral ribs. Aperture high, posterior corner somewhat drawn out and grove-shaped, anterior corner evenly rounded. Outer lip prosocline, not thickened by labial varix. Umbilical chink conspicuous.
Dimensions. Height of holotype 1.96 mm, breadth 1.14 mm, height of aperture 0.88 mm, breadth 0.66 mm.

Remarks: Benthonellania oligostigma resembles *B. agastachys* (Fig. 1584), but has a more slender shape, lacks the adapical spiral lines, has curved axial ribs, and has an almost smooth protoconch. Among the other species of *Benthonellania*, it is only *B. fayalensis* (Figs 1585-8), from the Azores, which bears any resemblance, but that species has a less crenulated appearence of the ribs at the adapical suture and more convex whorls.

Benthonellania agastachys sp.n. Figs 1584, 1592-1593

Type material: Holotype in RMNH.

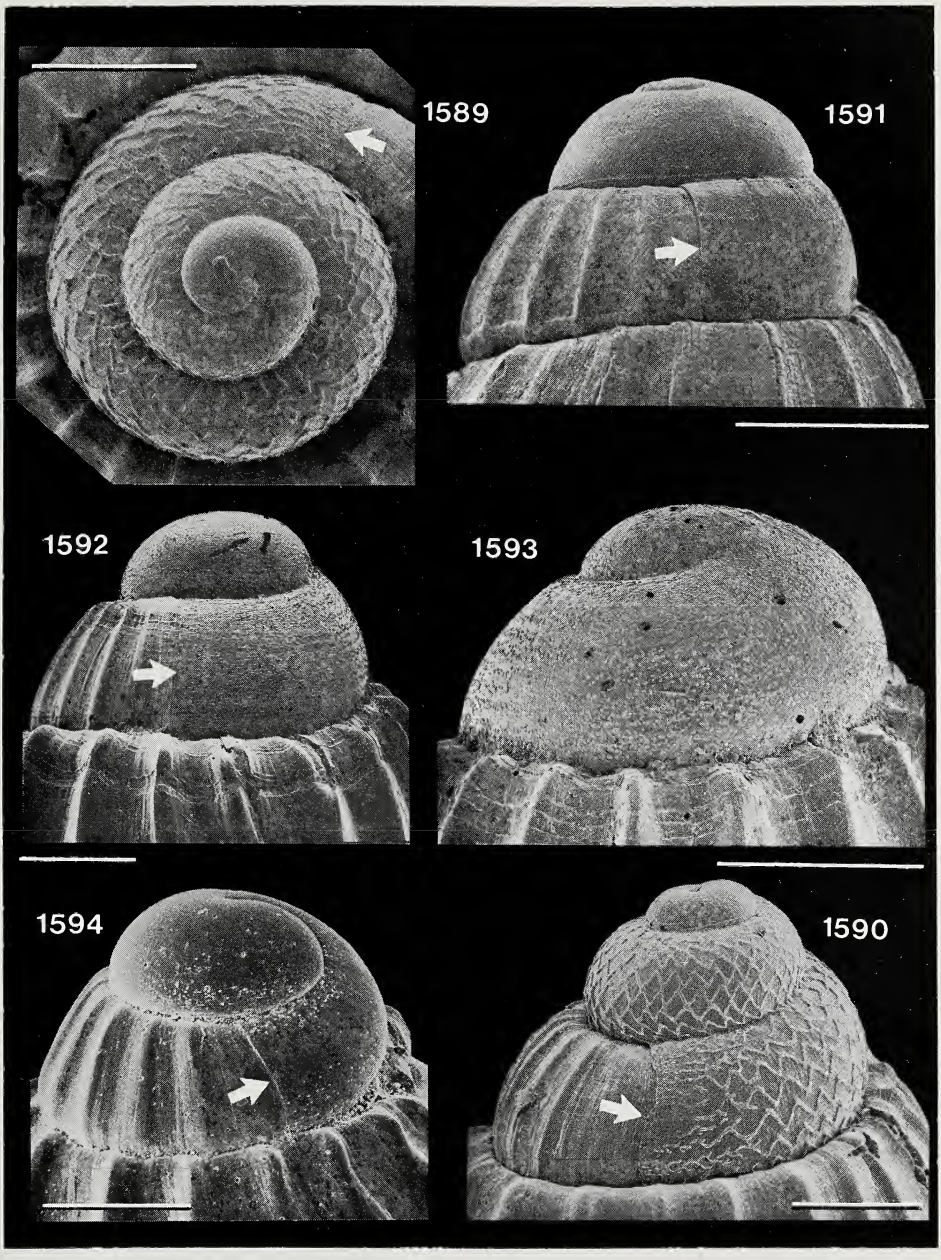
Type locality: CANCAP st 2.058, 27°58' N, 13°15' W, 500 m.

Material examined: Only known from the holotype.

Distribution: Only known from off southern Morocco in 500 m.

Description: Shell (Fig. 1584) small, broadly conical, colourless, and blunt. Larval shell (Figs 1592-3) dome-shaped, densely granulated, with some tendency of spiral arrangement of granules, consisting of 1.1 whorls and of a diameter of 490 μm. Teleoconch with 2.25 whorls of rapidly increasing diameter. Axial sculpture of broad, straight, rounded ribs, 20 on body-whorl, ending abruptly at adapical suture, barely crossing first basal spiral rib. Spiral sculpture of 2-4 spirals, starting on first teleoconch whorl as fine lines, then becoming stronger furrows and together producing a distinct dent in each axial rib at intersections. 4-5 basal, flat and low spiral ribs, strongest at periphery, not present above suture. Aperture not fully formed and partly damaged. Umbilical chink conspicuous.
Dimensions. Height 1.82 mm, breadth 1.32 mm.
Etymology: Agastachys (Greek) rich in grain.

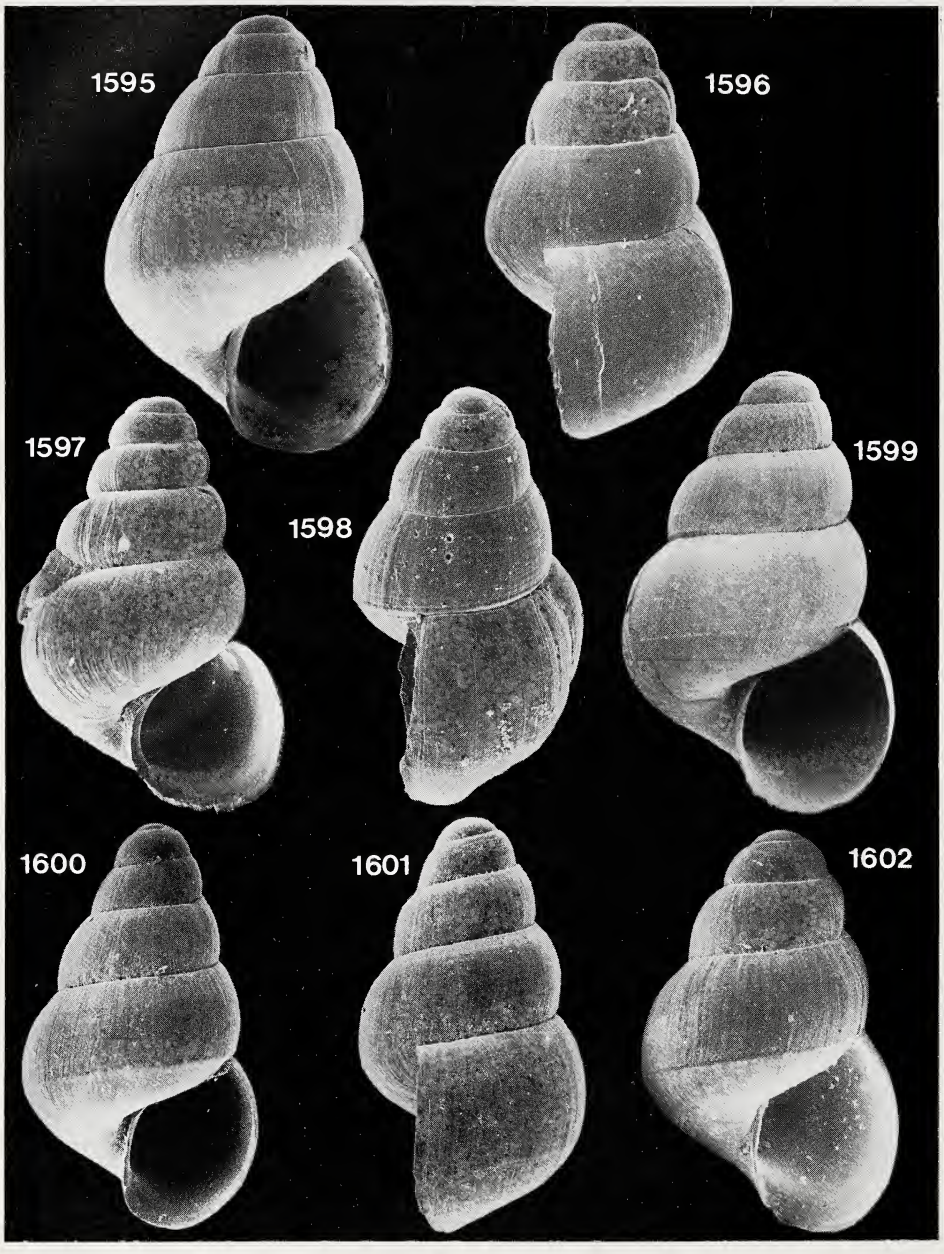
Remarks: Benthonellania agastachys is based on a single, immature and somewhat broken shell, but quite characteristic with its very broad shape and crenulated suture. It is closely related to *B. fayalensis* and *B. oligostigma*, but broader than any of them. The larval shell is more dome-shaped than in *B. oligostigma* (Fig. 1594) and the ribs are more close-set and give the suture a more strongly crenulated appearence than in *B. fayalensis* (Figs 1585-8).



Figures 1589-1594. Protoconchs of *Benthonellania*. **1589-1590**, *B. gofasi*, MONACO Exp st 1116. **1591**, *B. fayalensis*, MONACO Exp st 233. **1592-1593**, *B. agastachys*, holotype. **1594**, *B. oligostigma*, holotype.

Scale lines 200 μm.

The arrows indicate the protoconch - teleoconch demarcation.



Figures 1595-1602. Genus *Pseudosetia*. **1595-1596**, *P. ficaratiensis*, BALGIM st DW116, 1.8 and 1.5 mm. **1597**, *P. semipellucida*, NORBI st CP10, 3.1 mm. **1598**, *P. turgida*, THALASSA st Z446, 1.7 mm. **1599**, *P. turgida*, off Korsfjorden, Norway, 400 m, 2.2 mm. **1600-1601**, *P. turgida*, off Korsfjorden, Norway, 275 m, 2.0 and 2.7 mm. **1602**, *P. turgida*, THALASSA st Z446, 1.6 mm.

Genus *PSEUDOSETIA* Monterosato, 1884

Pseudosetia Monterosato, 1884:281. Type species, subsequent designation (by Crosse 1885:140), *Rissoa turgida* Jeffreys, 1870. North European.

Remarks: Ponder (1985a) used *Pseudosetia* for *P. turgida* only, and as a subgenus of *Pusillina*. We have included a number of additional species, based on similarities in shell characters.

Ponder distinguished *Pusillina* and *Pseudosetia* mainly on anatomical characters, and we have not made any attempts to check them, but the sculpture of the protoconch (Figs 1603-14) of the species here classified in *Pseudosetia* is uniform and unique among all European rissoids. We therefore feel confident that the species are congeneric.

The species here included in *Pseudosetia* all have paucispiral protoconchs without distinction between protoconch I and protoconch II. Inferred lecithotrophic development is supported by the finding of several egg-capsules with embryos of *P. turgida* (Fig. 1380).

The protoconch sculpture consists of micro-tubercles and interrupted spiral lines, in some cases the lines dominate, in others the micro-tubercles. In the species that we have classified in *Pusillina*, there is a similar variation, although most species only have micro-tubercles.

A very similar protoconch sculpture is also present in *Setia pulcherrima* (Ponder 1985a:fig, 85G) the type species of *Setia*, and we believe the two genera to be closely related.

The teleoconch of species of *Pseudosetia* is rather cylindrical (due to the large larval shell), thin-shelled, has a very indistinct reticulate sculpture and the parietal wall (which is extremely thin) is concealed by the bulging body-whorl, when the shell is placed with its axis horizontally.

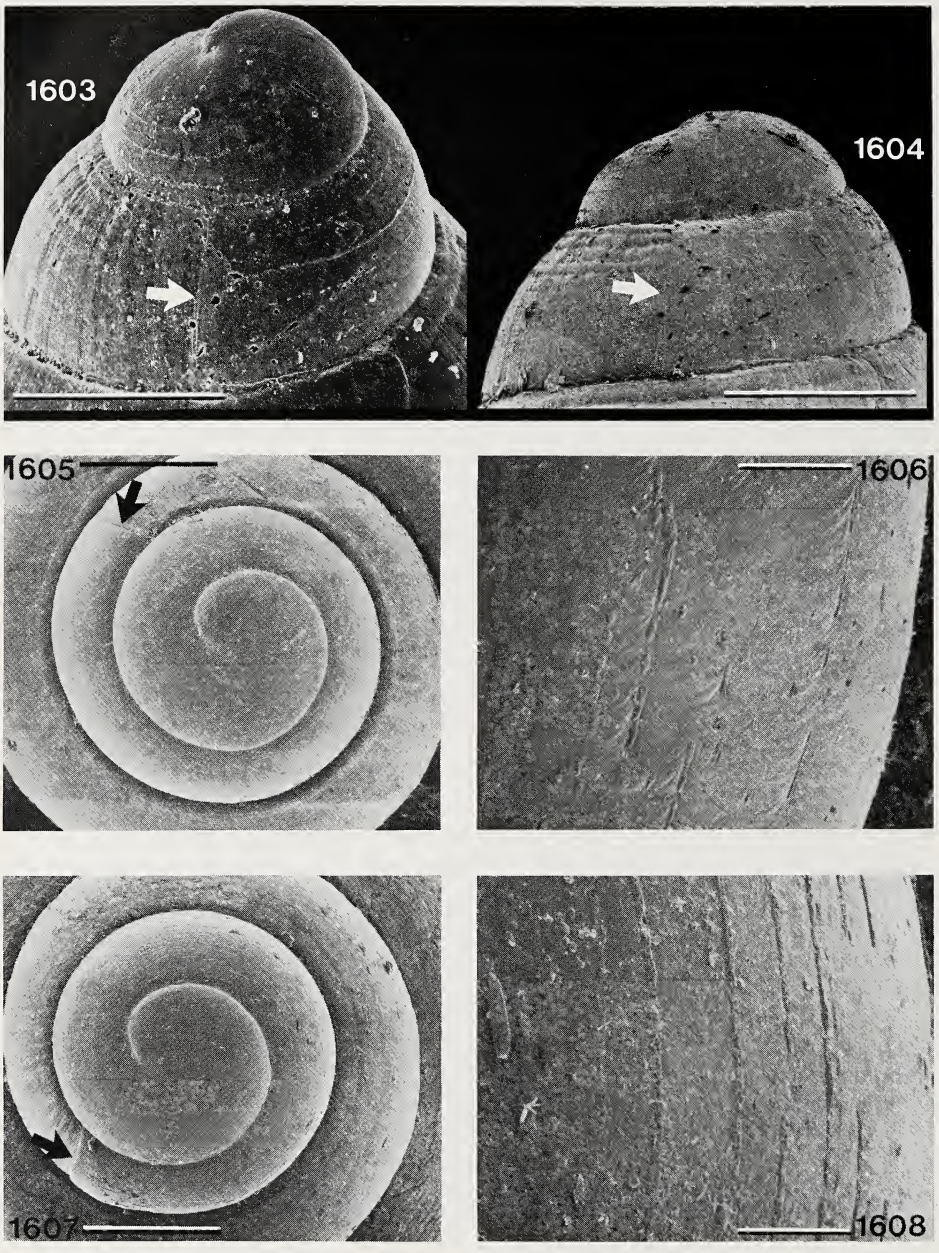
Alaba conoidea Dall, 1889, from deep water off Florida is very similar to some of the European species of *Pseudosetia* and is a likely candidate for the genus.

Pseudosetia amydralox sp.n. Figs 1609-1612, 1618-1622

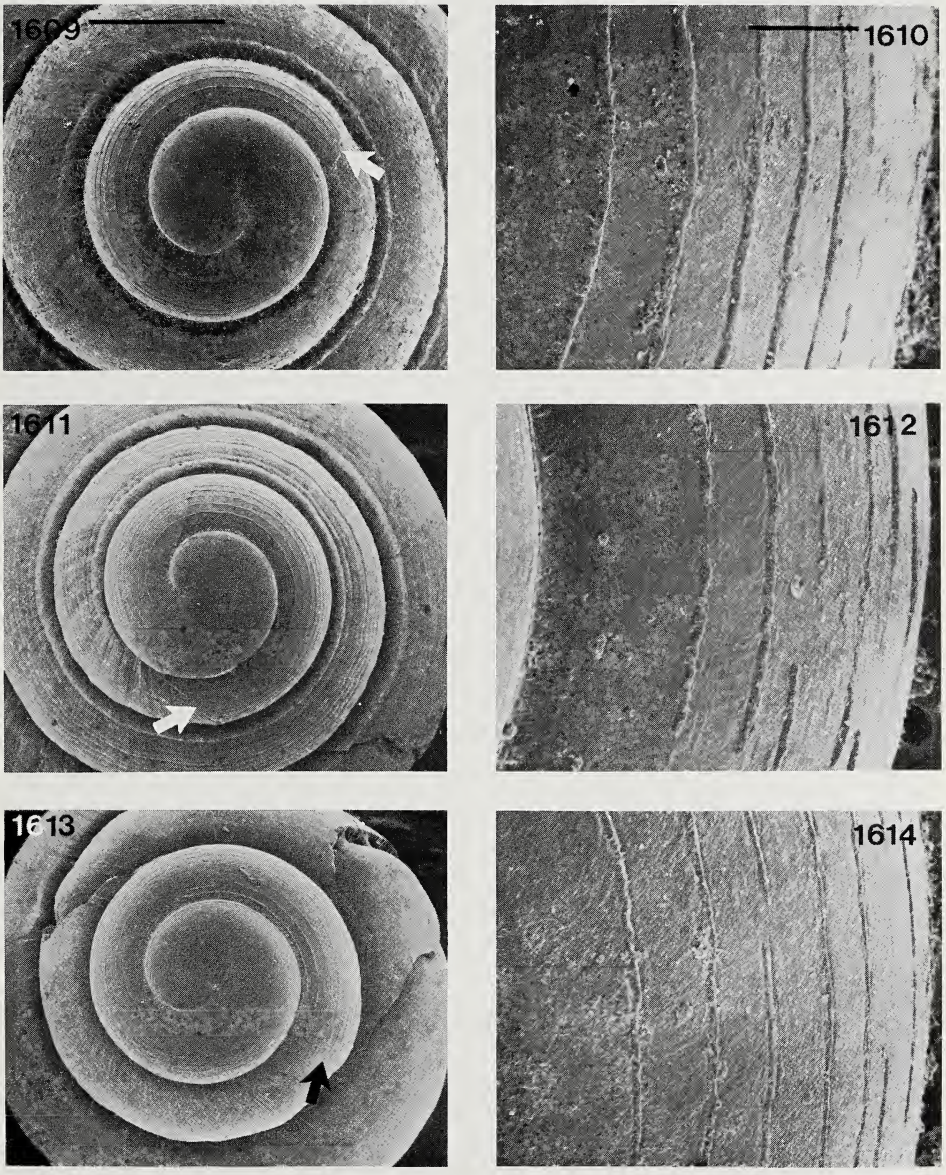
Type material: Holotype in MNHN, numerous paratypes in MNHN and SMNH 4358.

Type locality: SEAMOUNT st CP20, 36°34' N, 11°30' W, 305-320 m, Gorringe Bank.

Material examined: The types and --SEAMOUNT st DW08, 36°29' N, 11°37' W, 470-485 m, 11 shs; st DW15, 36°33' N, 11°29' W, 300-330 m, 14 shs; st DW16, 36°33' N, 11°36' W, 255-265 m, 152 shs; st DW17, 36°30' N, 11°31' W, 155 m, 3 shs; st DW21, 36°35' N, 11°28' W, 460-480 m, 7 shs; st CP28, 36°38' N, 11°30' W, 605-675 m, 1 sh; st DW38, 36°42' N, 14°17' W, 235-245 m, 42 shs; st DE39, 36°40' N, 14°16' W, 207-222 m, 6 shs; st DW43, 36°45' N, 14°17' W, 260-285 m, 28 shs; st DW45, 36°46' N, 14°18' W, 315-335 m, 104 shs; st DW60, 36°43' N, 14°17' W, 240-255 m, 5 shs; st DW61, 36°40' N, 14°16' W, 200-205 m, 132 spms; st DW63, 35°14' N, 15°35' W, 630 m, 4 shs; st DE80, 33°49' N, 16°23' W, 250-256 m, 2 shs; st DE84, 33°43' N, 14°24' W, 450-455 m, 2 shs; st DE95, 35°05' N, 12°55' W, 197-210 m, 3 shs; st DE98, 35°03' N, 12°55' W, 300-325 m, 138 shs; st CP99, 35°04' N, 12°55' W, 225-280 m, 19 shs; st DW108, 42°51' N, 11°53' W, 1110-1125 m, 14 shs; st DW111, 42°40' N, 11°36' W, 675-685 m, 3 shs; st DW116, 42°54' N, 11°51' W, 985-1000 m, 67 spms; THALASSA st X353, 44°07' N, 04°45' W, 645 m, 2 spms; st X362, 44°07' N, 04°51' W, 590 m, 2 spms; st Y392, 41°20' N, 09°12' W, 550 m, 1 spm; BALGIM st DR40, 35°50' N, 06°09' W, 362 m, 2 shs; st DW50, 35°53' N, 06°32' W, 522 m, 4 shs; CANCAP st 2.058, 27°58' N, 13°15' W, 500 m, 1 sh; st 2.085, 28°02' N, 14°30' W, 600 m, 2 shs; st 2.157, 27°35' N, 17°59' W, 1650 m, 1 sh; st 3.068, 30°07' N, 15°53' W, 310 m, 7 shs; st 3.071, 30°07' N, 15°54' W, 748 m, 1 sh; st 3.102, 30°07' N, 15°53' W, 600 m, 5 shs; PORCUPINE Exp 1870 st 30, 36°15' N, 06°52' W, 702 m, 5 shs (coll. Sykes, BMNH; det *Rissoa electa* var. *laevis*); st 34, 35°44' N, 06°53' W, 753 m, 1 spm (USNM 183642); Sicily, Messina, Plio-Pleistocene fossil (USNM 183643, ex Seguenza).



Figures 1603-1608. Protoconchs of *Pseudosetia*. **1603-1604**, *P. azorica*, BARTLETT st 4. **1605-1606**, *P. turgida*, off Tromsö, Norway, 350 m. **1607-1608**, *P. turgida*, THALASSA st Z435.
Scale lines 200 μm (1603-1605, 1607), 20 μm (1606, 1608).
The arrows indicate the protoconch - teleoconch demarcation.



Figures 1609-1614. Genus *Pseudosetia*. **1609-1610**, *P. amydralox*, CANCAP st 3.102. **1611-1612**, *P. amydralox*, SEAMOUNT st DW116. **1613-1614**, *P. ficaratiensis*, BALGIM st DW116.
Scale lines 200 μm (1609, 1611, 1613), 20 μm (1610, 1612, 1614).
The arrows indicate the protoconch - teleoconch demarcation.

Distribution: Only known from the material examined, from off northern Spain, south to the Canaries, in 155 to 1650 m.

Description: Shell (Figs 1618-22) small, vitreous, colourless, fairly solid, conical, with large aperture and blunt apex. Larval shell (Figs 1609-12) depressed dome-shaped, consisting of 1.5 whorls sculptured with rows of very small granules, sometimes, especially in southern populations, fused to form spiral lines. Diameter 470 μm. Teleoconch with 2.7 rather flat, in the Canaries more convex whorls. Suture shallowly channelled. The axial sculpture consists of scattered, sharp incremental lines and wrinkles. Spiral sculpture consists of a strong rib, forming the projection of the suture, visible only on the body-whorl and a very fine, indistinct cover of incised spiral lines covering all the surface, but less developed below the spiral rib. Aperture rounded, parietal callus poorly developed. Outer lip thin and sharp, rarely with a varix shortly behind the edge (Fig. 1619). Inner lip reflected over the poorly developed, often absent umbilical crevice.
Dimensions. Height of shell 1.80 mm, breadth 1.04 mm.

Etymology: Amydros (Greek) - indistinct, loxos (Greek) slope.

Remarks: The shells taken by the CANCAP Expeditions (Fig. 1618) differ by having more well developed spiral sculpture on the protoconch and more convex whorls, but there is a variation in this, so some of the CANCAP specimens cannot be distinguished from the northern ones. We therefore find it better not to separate them.

Pseudosetia amydralox resembles *P. turgida* (Figs 1598-1602) in most features, but the larval shell has a stronger spiral sculpture than *turgida* (Figs 1605-8) and its teleoconch is more solid and has more distinct spiral sculpture.

Pseudosetia ficaratiensis (Brugnone, 1876) Figs 1595-1596, 1613-1614

Rissoa ficaratiensis Brugnone, 1876:21.
Rissoa ficaratiensis: Verduin 1984:70.

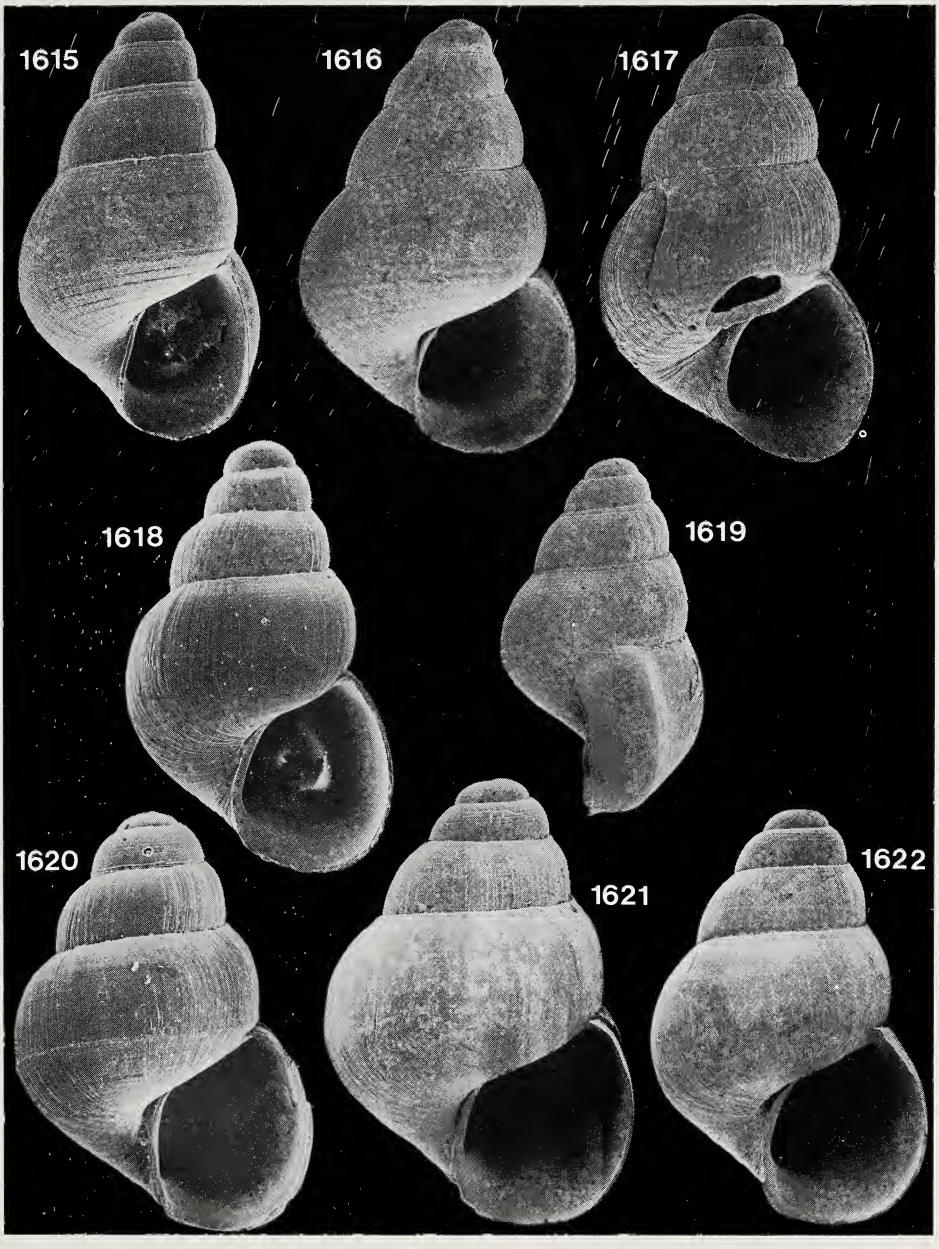
*Type material:*One syntype in coll. Brugnone, Museo di Zoologia, Roma.

Type locality: Plio-Pleistocene fossil, Ficarazzi, near Palermo, Sicily.

Material examined: The types and --BALGIM st DR40, 35°50' N, 06°09' W, 362 m, 3 spms; st DW43, 35°54' N, 06°14' W, 150 m, 1 sh; st DW50, 35°53' N, 06°32' W, 522 m, 5 shs; st DW57, 35°42' N, 06°35' W, 548 m, 1 spm; st DR115, 35°47' N, 06°04' W, 332 m, 1 sh; st DW116, 35°49' N, 06°04' W, 322-365 m, 69 spms; --PORCUPINE Exp 1870 st 17, 39°42' N, 09°43' W, 1092-1993 m, 8 shs (coll. Sykes, BMNH).

Distribution: Off southwestern Portugal and the Strait of Gibraltar, 150-2000 m; also Plio-Pleistocene fossil in Sicily.

Redescription: Shell (Figs 1595-6) smooth, polished, transparent, of simplified rissoid shape, broadly and conically ovate, with blunt apex and fairly large aperture. Larval shell (Figs 1613-4) depressed dome-shaped, of 1.45 flattened whorls, sculptured with a few scattered and interrupted spiral streaks, more crowded towards the teleoconch. Diameter 480 μm. Teleoconch with 2.5 slightly convex whorls, sculptured by irregularly appearing and indistinct incremental lines and scattered, irregular traces of spiral lines. Suture distinct but shallow. Aperture regularly ovate. Parietal callus very thin and retracted some distance into the aperture. Outer lip thin, sharp and orthocline. Inner lip solid and concealing the umbilical crevice in most specimens.
Dimensions. Height 1.85 mm, breadth 1.19 mm.



Figures 1615-1622. Genus *Pseudosetia*. **1615**, *P. azorica*, BARTLETT st 4, 1.6 mm. **1616-1617**, *P. azorica*, BARTLETT st 2, 1.9 and 1.8 mm. **1618**, *P. amydralox*, CANCAP st 3.102, 1.95 mm. **1619-1620**, *P. amydralox*, SEAMOUNT st DW116, 1.7 and 1.6 mm. **1621-1622**, *P. amydralox*, SEAMOUNT st DE98, both 1.8 mm.

Remarks: Pseudosetia ficaratiensis differs from *P. amydralox* (Figs 1618-22) in having no traces of a regular spiral sculpture or the spiral rib which marks the level of the suture on the body whorl. Furthermore, it has flatter whorls and a more regularly ovate shape.

Monterosato (1884:75) classified it in *Pseudosetia* and placed it close to *turgida*, based on the type that he had acquired with the Brugnone collection.

Brugnone's description is quite detailed and he mentioned that it is smooth, not weakly striated as *"Rissoa galvagni* Aradas" [= *Crisilla pseudocingulata* (Nordsieck, 1972) *fide* Verduin 1984].

The name *Rissoa ficaratiensis* was discussed by Verduin (1984), who regarded it as a *nomen dubium* since he had not been able to examine any type material. Warén has examined a syntype in the Monterosato collection in Rome, which agrees in all detail with our present specimens. To avoid future problems about the identity of our specimens, we have given a redescription.

Pseudosetia azorica sp.n. Figs 1603-1604, 1615-1617

Type material: Holotype ZMC GAS-120, paratype in MNHN.

Type locality: BARTLETT st 2, 37°13.8' N, 28°44.5' W, 480 m, the Azores.

Material examined: The types and --BARTLETT st 4, 38°10' N, 28°53' W, 800-750 m, 2 shs (ZMC); BIACORES st 156, 37°37.5' N, 25°54.5' W, 350 m, 1 sh.

Distribution: Only known from the Azores, in 350-800 m.

Description: Shell (Figs 1615-7) *Rissoa*-like, small, rather fragile, colourless and blunt. Larval shell (Figs 1603-4) of 1.4 dome-shaped whorls, sculptured by a few scattered and indistinct spiral lines and measuring 340 μm in diameter. Teleoconch of 3.1 distinctly convex whorls. Axial sculpture of fine, straight incremental lines, together with fine spiral sculpture on apical whorls, giving shell a minutely reticulate appearence. Adapical part of whorls with 1-3 stronger impressed lines; a stronger spiral rib just above abapical suture; 5-7 additional spiral ribs on basal surface. Aperture somewhat squarish; parietal callus a thin glaze, normally concealed by bulging body-whorl. Umbilicus a very narrow chink. Outer lip thickened by solid rib just before edge.
Dimensions. Height of holotype 1.76 mm, breadth 1.08 mm, height of aperture 0,70 mm, breadth 0.56 mm.
Etymology: Azorica - from the Azores.

Remarks: Pseudosetia azorica resembles the other European species of *Pseudosetia*, but has stronger basal sculpture than any of them.

Pseudosetia semipellucida (Friele, 1879) Figs 1517, 1597

Rissoa semipellucida Friele, 1879:274.
Cingula semipellucida: Bouchet & Warén 1979a:222, fig. 42.

Type material: 3 syntypes, ZMB 20860.

Type locality: NORWEGIAN NORTH ATLANTIC Exp st 353, 77°58' N, 05°10' E, 2438 m.

Material examined: Listed by Bouchet & Warén (1979:222), plus --INGOLF Exp st 113, 69°31' N, 07°06' W, 2382 m, 5 shs (ZMC); --BIOFAR st 274, 63°01' N, 07°49' W, 698 m, 2 spms; --st 502,

60°30' N, 08°04' W, 890 m, 1 spm.

Distribution: The abyssal parts of the Norwegian Basin, 700-3200m.

Remarks: Pseudosetia semipellucida is about 1.5 times as large as any other species of *Pseudosetia* we have seen and can also be distinguished by the protoconch, which consists of 2.0 whorls, not about 1.5 as in other species of the genus.

Pseudosetia turgida (Jeffreys, 1870) Figs 1380, 1598-1602, 1605-1608

Rissoa turgida Jeffreys, 1870:445.
Rissoa soluta var. *laevis* M. Sars, 1870:173 (*nom. nud.*).
Rissoa oblita (Tiberi MS) Monterosato, 1884:75 (in synonymy).

Type material: R. turgida, three syntypes, coll. Norman, BMNH 1911.10.26.24451-3 (Warén 1980:22); 5 syntypes in ZMB.

Type locality: R. turgida, Vallö and Dröbak, Oslofjord, 72-182 m.

Material examined: The types and --THALASSA st Z397, 47°34' N, 07°13' W, 511 m, 6 shs; st Z399, 47°35' N, 07°18' W, 825 m, 3 spms; st Z413, 48°03' N, 08°29' W, 805 m, 11 spms; st Z417, 48°12' N, 09°10' W, 865 m, 31 spms; st Z421, 48°23' N, 09°34' W, 950 m, 4 spms; st Z431, 48°38' N, 09°47' W, 800 m, 3 spm; st Z435, 48°40' N, 09°53' W, 1050 m, 3 spms; st Z446, 48°47' N, 11°08' W, 1470 m, 3 spms; st Z447, 48°47' N, 11°13' W, 1490 m, 1 spm; st Z457, 48°38' N, 09°53' W, 800 m, 1 spm; The Skagerrak and Norway, north to off Murmansk (NORWEGIAN NORTH ATLANTIC Exp st 267, 72 N), 90-700 m, 47 lots with 2650 spms (SMNH, ZMO, ZMB). Not found by the PORCUPINE Exp; such records are based on *P. amydralox*.

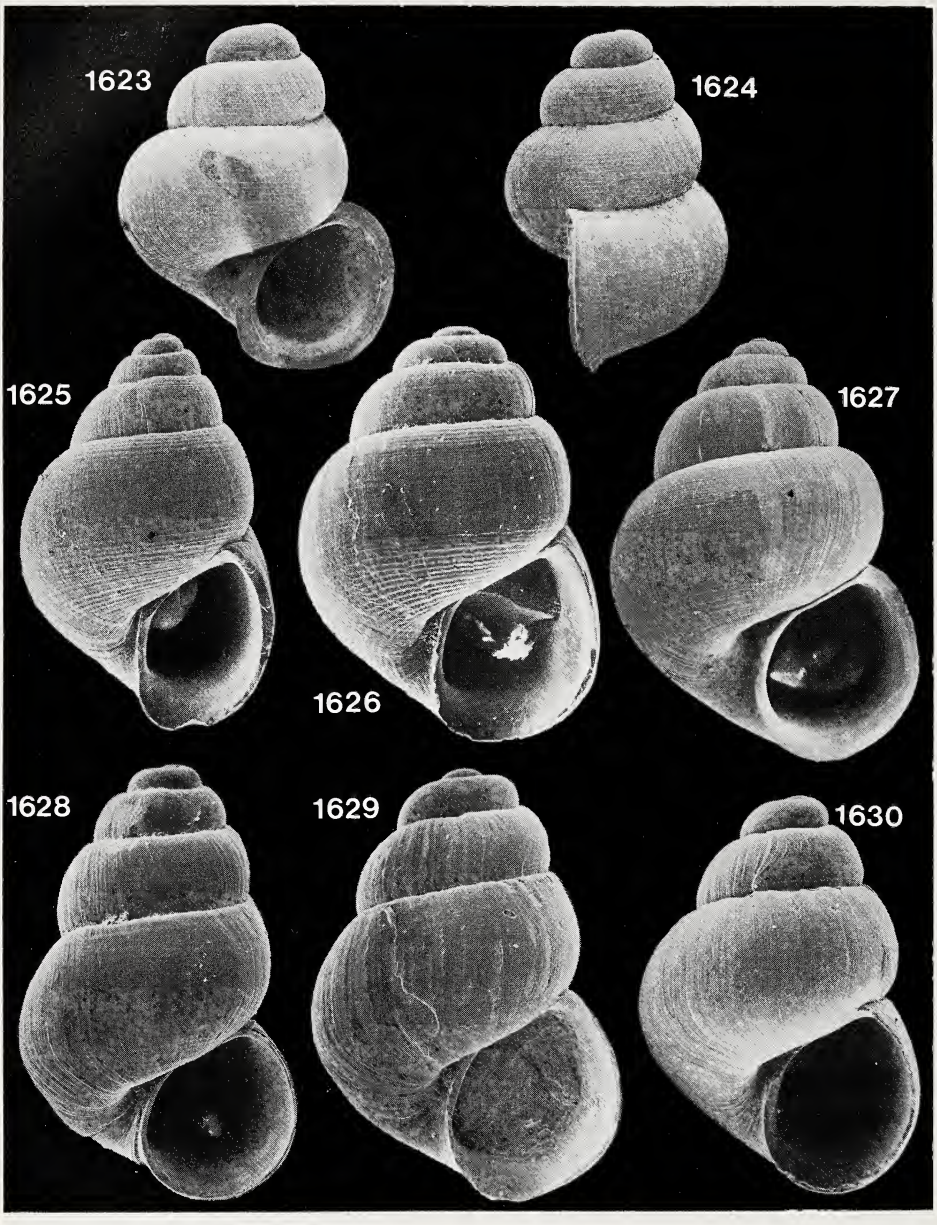
Distribution: From off northern Norway to the northern part of the Bay of Biscay, in 90-1500 m. Not known from Iceland or the Faroes.

Remarks: Pseudosetia turgida has evidently been overlooked around the British Isles, since it is common on the continental shelf and in the fjords in Scandinavia and in the northern part of the Bay of Biscay.

Pseudosetia turgida has an almost smooth, fragile shell and most specimens we have seen in museum collections are more or less broken.

Monterosato (1884) considered *Rissoa obtusispira* Seguenza a synonym of *P. turgida*, but we question this synonymy, see discussion at *Obtusella*.

We have seen a single shell from the Mediterranean that belongs to *P. turgida*: this is a fossil of undetermined age from Messina (USNM 183643 ex Seguenza). *P. turgida* has by several authors been recorded as Recent from the Mediterranean, but we have not seen any material and agree with Oliverio *et al.* (1986) who concluded that it belongs to "Mare del Nord".



Figures 1623-1630. Genera *Amphirissoa* and *Obtusella*. **1623-1624**, *Amphirissoa cyclostomoides*, paralectotypes, MONACO Exp st 719, both 1.4 mm. **1625**, *O. roseotincta*, MONACO Exp st 703, 1.5 mm. **1626**, *O. intersecta*, BALGIM st DW132, 0.9 mm. **1627**, *O. intersecta*, Koster area, Sweden, 2.0 mm. **1628-1629**, *O. macilenta*, off Banyuls, 254-270 m, 1.15 and 0.75 mm. **1630**, *O. macilenta*, syntype of *Rissoa concinnata* Jeffreys, 0.7 mm (USNM 202239).

Genus *OBTUSELLA* Cossmann, 1921

Cingulina Monterosato, 1884:626 (not A. Adams, 1860). Type species, by monotypy, *Rissoa obtusa* Cantraine, 1842 (not Anton, 1838) = *Rissoa intersecta* S.V. Wood, 1857. Europe.
Obtusella Cossmann, 1921:43, *nom. nov.* for *Cingulina* Monterosato, 1884, not A. Adams, 1860.

Remarks: The Mediterranean species were reviewed by Amati (1986). Two species occur on the outer part of the continental shelf off Europe. *Setia roseotincta* from the Azores belongs here, but it is not known whether it is a deep-sea species or not.

Rissoa (Setia) obtusispira G. Seguenza, 1876 was briefly described from Upper Pliocene deposits at Caltabiano, Sicily. It was said to be similar to "*R. (S.) obtusa* Cantraine" [= *Obtusella intersecta*] but with "less convex whorls, the last one faintly keeled, umbilical slit [present]". Synonymy with *Pseudosetia turgida* was suggested by Monterosato (1884:281), and L.Seguenza (1903:57, pl. 11 figs 23a-b) figured a specimen from the lower Pliocene of Trapani, near Messina. (This specimen is not necessarily conspecific with the species described by his father, since it originated from a different stratum.)

Nordsieck (1973:4) designated a "lectotype" of "*Putilla obtusispira* (Seguenza)" from Recent shells of *Bentonella tenella* collected in the Ionian Sea in the 1960s! This designation has, of course, no value, and *R. obtusispira* has probably nothing to do with *Benthonella tenella*, since G. Seguenza (1876) used *Hela* (= *Benthonella*), as a genus, for *B. tenella*, which he knew as recent from the Mediterranean and fossil from Messina.

We believe that *Rissoa (Setia) obtusispira* G. Seguenza was based on a species similar to *Obtusella macilenta* (which not had been described when Seguenza introduced his name), possibly related to *Obtusella sabelliana* Tabanelli, 1991 (Lower Pliocene, Forli, Italy).

Obtusella intersecta (S.V. Wood, 1857) Figs 1626-1627, 1633

Rissoa obtusa Cantraine, 1842:348 (not *R. obtusa* Anton, 1839, or *R. obtusa* Brown, 1841).
Rissoa soluta: Forbes & Hanley 1850:131, pl. 75 figs 3-4.
Rissoa intersecta S.V. Wood, 1857:318 (based on *R. soluta* sensu Forbes & Hanley, not *R. soluta* Philippi, 1844).
Rissoa alderi Jeffreys, 1858:127, pl. 5 fig. 5.
Rissoa globosa (H. Martin MS) Monterosato 1884:67 (in synonymy).
Putilla (Obtusella) cantrainei Nordsieck, 1972:156, fig. RIII35 (*nom. nov.* for *Rissoa obtusa* Cantraine, 1842).
Rissoa alderi: Warén 1980:22, pl. 4 fig. 11.
Cingula intersecta: Verduin 1984:58, figs 4, 23, 72.

Type localities. R. intersecta, "British"; *R. alderi*, Skye, Hebrides.

Type materials: R. intersecta, lost?; *R. alderi*, neotype designated by Warén (1980), USNM 183604.

Material examined: The Kattegat and the Skagerrak, Norway north to Bodö (67.3° N), 15-500 m, 45 samples with 4000 spms (SMNH, ZMC, ZMO, ZMB); The Faroes and southern and western Iceland, 10-120 m, 20 samples with 1200 spms (ZMC and Icelandic private collections); --BIOFAR st 056, 61°55' N, 06°29' W, 77 m, 2 shs; --PROCELT st K163, 48°08' N, 08°26' W, 235-300 m, 1 sh; -- st K224, 48°21' N, 10°12' W, 341-256 m, 1 spm; st K228, 48°18' N, 09°01' W, 250-232 m, 1 spm; -- BALGIM st DW43, 35°54' N, 06°14' W, 150 m, 5 spms; st DW132, 35°26' N, 04°19' W, 170 m, 48 shs; PORCUPINE Exp 1870, Adventure Bank, 167 m, 13 shs (coll. Sykes, BMNH); st Tangiers, 664 m, 12 shs (coll. Sykes, BMNH); st 56, 37°03' N, 11°36' E, 710 m (coll. Sykes, BMNH); --Corsi-

ca, Baie de Calvi, 60-120 m, 200 spms (SMNH); S France, off Banyuls, rech Lacaze, numerous specimens, down to 800 m (SMNH).

Distribution: From southwestern and southern Iceland, northern Norway (67° N), the Faroes and southwards along the European west coast, to the Mediterranean and northwestern Morocco, usually in 20-200 m, occasionally live taken down to 800 m.

Remarks: Obtusella intersecta is not a real deep-sea species, although it is found in the uppermost bathyal area, but it is included here since it occasionally is common there.

Verduin (1984) gave the year of publication for this species as "1856", but the date given in Wood's monograph is 1857 (on an unpaginated page with dates of publication of the parts).

Verduin (1984) considered *Rissoa alderi* a *nomen dubium* because the dimension given by Jeffreys in the original description (1/12 of an inch = 2.14 mm) considerably exceeded the maximum size of the shells of *O. intersecta* he had examined. Verduin agreed that the neotype selected by Warén (size 1.6 mm) was conspecific with *O. intersecta*, but "found it difficult to accept" the designation as a neotype of *alderi*, because "it cannot be demonstrated in a satisfactory way that its dimensions are consistent with what we know about those of *C. alderi*". We figure here (Fig. 1627) a specimen 2.0 mm high. We consider this size well within the margin of error of the size given by Jeffreys.

Monterosato (1872:37) said that there were types of *obtusa* in the collection of Schwartz von Mohrenstern, but no types could be found in NHMW (E. Wawra, pers. comm.).

Obtusella macilenta (Monterosato, 1880) Figs 1628-1630, 1634

Setia macilenta Monterosato, 1878:87 (*nom. nud.*).
Setia macilenta Monterosato, 1880:69.
Rissoa concinnata Jeffreys, 1883b:396, pl. 16 fig. 2.
Cingula (Setia) macilenta: van Aartsen & Verduin 1982:127.
Cingula macilenta: Verduin 1984:57, figs 22, 71.

Type materials: S. macilenta, possible syntypes BMNH, see Verduin (1984:57); *R. concinnata*, many syntypes, USNM 182860, 202239, see Warén (1980:22).

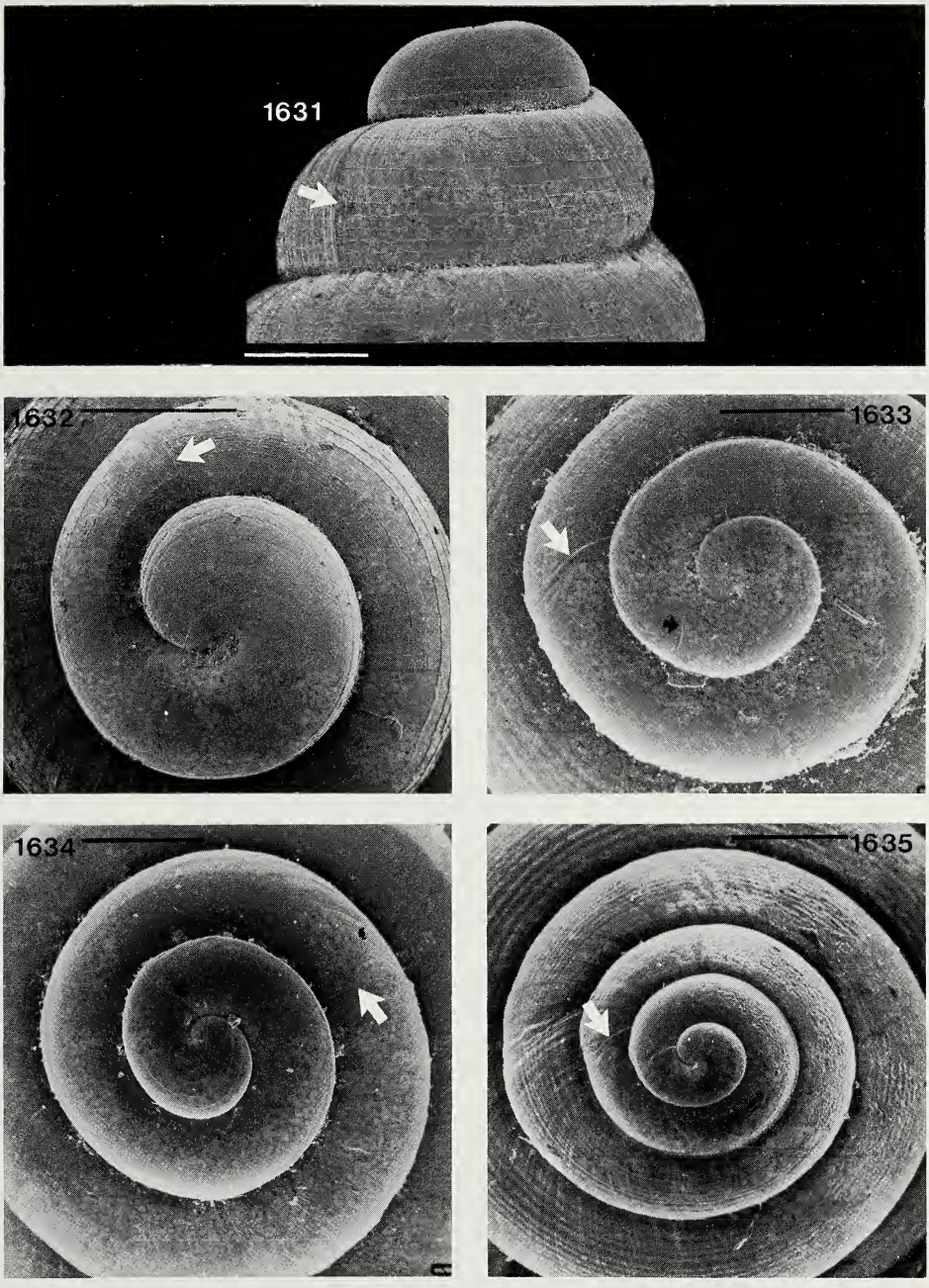
Type localities: S. macilenta, Palermo and Ustica, Sicily, 300 m; *R. concinnata*, off Crete, 127-216 m.

Material examined: BALGIM st DW74, 33°52' N, 08°13' W, 181 m, 1 spm; --st DW32, 36°47' N, 07°04' W, 250 m, 1 spm; Palermo, ex Monterosato, 13 spms (coll. Sykes, BMNH); off Sicily, 100 m (SMNH); off Siracusa, Sicily, 80-120 m, 50 shs (SMNH); --PORCUPINE Exp 1870, st 3, 48°31' N, 10°03' W, 1256 m, 1 sh (coll. Sykes, BMNH: see Remarks below); st 24, 37°19' N, 09°13' W, 531 m, 1 sh (coll. Sykes, BMNH); st Tripoli, 72-218 m, 9 shs (coll. Sykes, BMNH); st south of Siracusa, Sicily, 72 m, 9 shs (coll. Sykes, BMNH); st 56, 37°03' N, 11°36' E, 710 m, 30 shs (coll.Sykes, BMNH); st Adventure Bank, 167 m, 28 shs (USNM 183626; coll. Sykes, BMNH); Corsica, Baie de Calvi, 60-70-90-120-150 m, 5 samples, 1000 spms (SMNH); --S France, Banyuls, Rech Lacaze, 254-270-300-400-800 m, 5 lots, 25 spms (SMNH).

Distribution: The Ibero-Moroccan Gulf and the Mediterranean, in about 60-800 m. Northern limit uncertain.

Remarks: Obtusella macilenta is a very featureless species but can be recognized by the almost smooth, cylindrical shell.

The single record from the Bay of Biscay (PORCUPINE Exp 1870 st 3) should be considered un-



Figures 1631-1635. Genera *Amphirissoa* and *Obtusella*. **1631-1632**, *Amphirissoa cyclostomoides*, paralectotype. **1633**, *Obtusella intersecta*, Calvi, Corsica. **1634**, *O. macilenta*, Calvi, Corsica. **1635**, *O. roseotincta*, MONACO Exp st 703 (MNHN).

Scale lines 200 μm (1631, 1632, 1635), 100 μm (1633, 1634).

The black arrows indicate the protoconch I - protoconch II demarcation. The white arrows indicate the protoconch II - teleoconch demarcation.

certain. Confusion of localities from that expedition are common, although the material in coll. Sykes usually is reliably labelled.

Obtusella roseotincta (Dautzenberg, 1889) Fig. 1625

Setia roseotincta Dautzenberg, 1889:53, pl. 3 fig. 6a-b.

Type material: Holotype in MOM.

Type locality: MONACO Exp st 112, 38°34.5' N, 28°06' W, 1287 m, between Pico and Saô Jorge, the Azores.

Material examined: MONACO Exp st 703, 39°21' N, 31°06' W, 1360 m, 2 shs (MNHN), 4 shs (MOM), 2 shs (IRSN).

Distribution: Only known from the material examined from the Azores in 1287-1360 m.

Remarks: The holotype has slightly less convex whorls than the specimen figured here, but it is also much worn with no trace of sculpture. It is distinctly reddish. The shape of the shell and the sculpture makes it clear that this species belongs to *Obtusella*.

Setia roseotincta was not found by Gofas (1990), and we do not know of any additional material. The reddish colour, however, indicates that this is a species living more shallow than it was found.

Genus *AMPHIRISSOA* Dautzenberg & Fischer, 1897

Amphirissoa Dautzenberg & Fischer, 1897:40. Type species, by monotypy, *A. cyclostomoides* Dautzenberg & Fischer, 1897. The Azores.

Remarks: Amphirissoa was recognized as a distinct genus by Ponder (1985a) and we can see little reason to question this, although the shell draws one's thought to *Obtusella*.

Amphirissoa cyclostomoides Dautzenberg & Fischer, 1897
Figs 1623-1624, 1631-1632

Amphirissoa cyclostomoides Dautzenberg & Fischer, 1897:161, pl. 3 figs 6-8.
Amphirissoa cyclostomoides: Ponder 1985a:72, fig. 47.

Type material: Lectotype selected (ICZN art.74b) by Ponder (1985a:72), in MOM, destroyed by acidic glass tube; paralectotypes in MNHN, IRSN, BMNH.

Type locality: MONACO Exp st 719, 39°11' N, 29°06' W, 1600 m, the Azores.

Material examined: The paralectotypes in MNHN and IRSN.

Distribution: Only known from the type locality, the Azores, in 1600 m.

Remarks: Amphirissoa cyclostomoides resembles the small species of *Obtusella*, but can be separated by having a double peristome and by its broader shape and more convex whorls. It has not been found since the original description.

Genus *BENTHONELLA* Dall, 1889

Benthonella Dall, 1889:25. Type species, by original designation, *Benthonella gaza* Dall, 1889. Caribbean.

Remarks: The strongly keeled, brownish protoconch and vitreous teleoconch set this genus apart from all other rissoids, although *Benthonellania* has shell characters that somewhat bridge this gap. Species of *Benthonella* appear to occur worldwide in deep-water at middle and low latitudes.

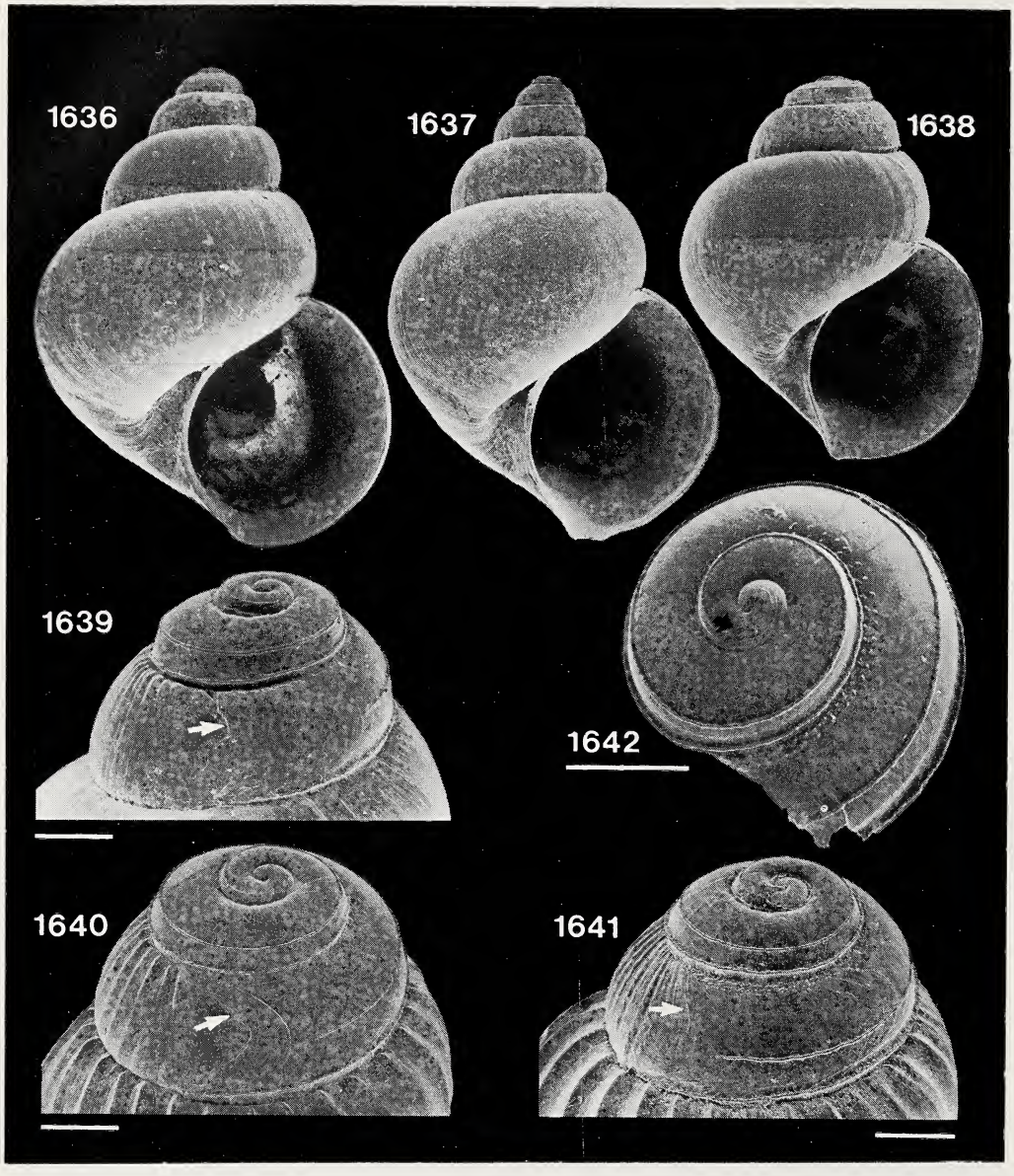
Benthonella tenella (Jeffreys, 1869) Figs 1636-1650

Lacuna tenella Jeffreys, 1869:204, pl. 101 fig. 7.
Cithna tenella var. *costulata* Jeffreys, 1883a:110.
Benthonella fischeri Dall, 1889:282. (June 1889).
Benthonella gaza Dall, 1889:282.
Cithna jeffreysi Dautzenberg, 1889:44, pl. 2 figs 8a-c. (15 October 1889).
Lacuna abyssorum Locard, 1896a:211; 1896b:163, pl. 5 fig. 7.
Assiminopsis abyssorum Locard, 1897:466, pl. 19 figs 24-27.
Rissoa amblia var. *inornata* Dautzenberg, 1927:126.
Benthonella kullenbergi Odhner, 1960:387, pl. 2 figs 18-19.
Putilla abyssicola Nordsieck, 1972:155, fig. R III 27.

Type materials: L. tenella, holotype USNM 185875 (figured by Warén 1980:pl.4 fig. 1) and two broken paratypes, USNM 186435; *C. tenella* var. *costulata*, 3 syntypes USNM 186437; *C. jeffreysi*, lectotype, here selected, the shell figured by Dautzenberg in MOM; *B. fischeri*, 3 syntypes USNM 93804; *B. gaza*, holotype USNM 94091; *L. abyssorum*, lost, not in Université de Lyon, not in MNHN; *A. abyssorum*, syntypes in MNHN; *R. amblia* var. *inornata*, one syntype in MOM marked by Dautzenberg "à figurer"; *P. abyssicola*, syntypes in SMF; *B. kullenbergi*, holotype in Göteborgs Naturhistoriska Museum.

Type localities: L. tenella, north of the Hebrides, British Isles; *C. tenella* var. *costulata*, no type locality cited for the variety in the original description, the syntypes are from PORCUPINE 1870 st 17, 39°42' N, 09°43' W, 1092-1993 m, off Portugal; *C. jeffreysi*, MONACO Exp st 112, 38°35' N, 28°06' W, 1287 m, the Azores; *B. fischeri*, USFC st 2384, 28°45' N, 88°15' W, 1730 m, Gulf of Mexico; *B. gaza*, USFC st 2352, 22°35' N, 84°23' W, 850 m, off Cuba; *L. abyssorum*, CAUDAN st 2, 46°28' N, 07°00' W, 1710 m, Bay of Biscay; *A. abyssorum*, TRAVAILLEUR 1881 dr 30, 35°25' N, 07°59' W, 1205 m, off NW Africa; *R. amblia* var. *inornata*, MONACO Exp st 1349, 38°36' N, 28°06' W, 1250 m; *P. abyssicola*, METEOR st D1, 36°29' N, 20°39E, 2700 m, Ionian Sea (Nordsieck 1973:4); *B. kullenbergi*, SWEDISH DEEPSEA Exp st 373, 28°25' N, 61°05' W, 5500-5987 m, western Central Atlantic.

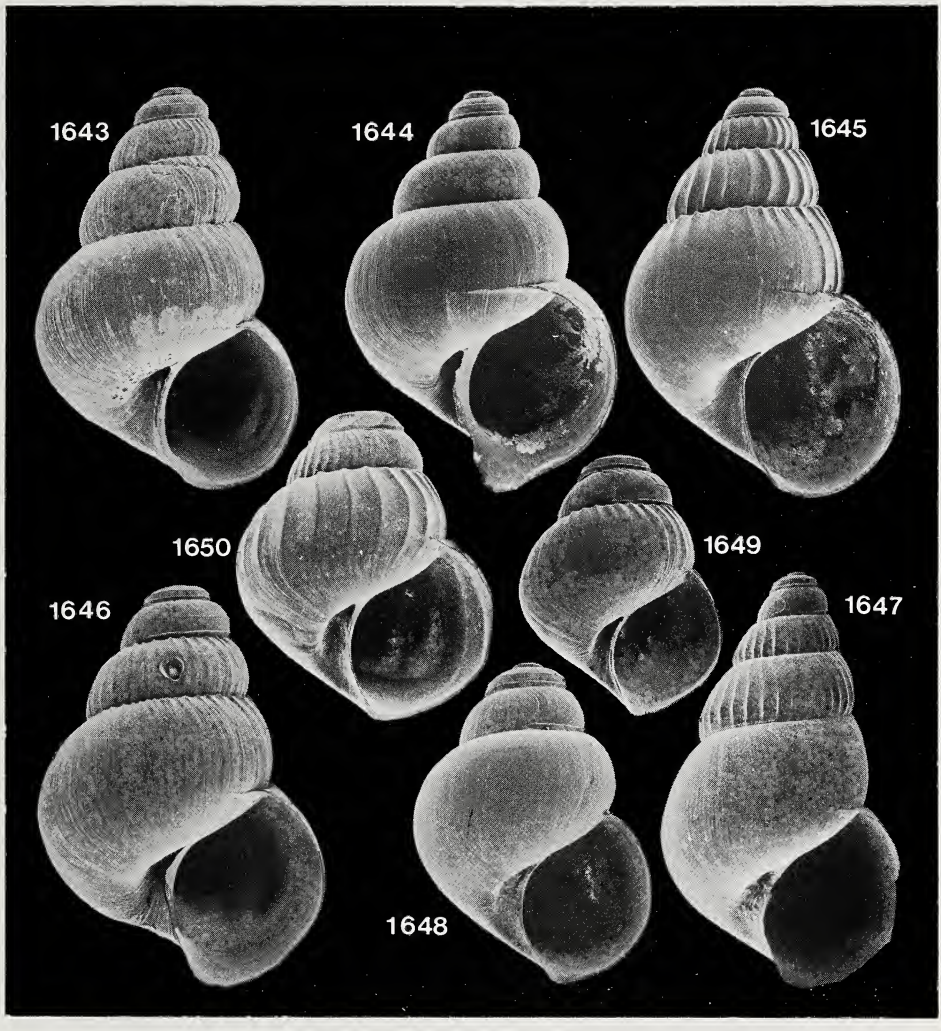
Material examined: The type material listed above and 200 lots with more than 20,000 shells and specimens.



Figures 1636-1642. *Benthonella tenella*. **1636**, DISCOVERY st 50605#1, 50°11' N, 13°23' W, 2820-2930 m, 4.2 mm. **1637-1639**, BIOMEDE 2 st 6, 39°40' N, 04°56' E, 2610 m, 4.3 mm (1637) and 1.9 mm (1638). **1640**, MONACO Exp st 703, 39°21' N, 31°06' W, 1360 m. **1641**, WALVIS st DS9, 27°00' S, 01°06' E, 5220 m. **1642**, larva from plancton off Naples, Tyrrhenian Sea. Scale lines 200 μm.

The black arrow indicates the protoconch I - protoconch II demarcation; the white arrows indicate the protoconch - teleoconch demarcation.

Distribution: From southern Iceland southwest of the Faroes (61°15'N, 09°35'W) and the British Isles as far north as Shetland, southwards along and off the European continental slope; the eastern and western basins of the Mediterranean; Madeira and the Azores. The southern distribution is patchily known, but the *fischeri* form extends at least as far south as the Canaries. Scattered samples of the *kullenbergi* form, from deep-water in the central and southern Atlantic have been examined. In the western Atlantic it is common off the northeastern United States (Rex *et al.* 1979) and ranges to the Caribbean. The distribution off South America is not known.



Figures 1643-1650. *Benthonella tenella*. **1643**, MONACO Exp st 738, 37°40' N, 26°26' W, 1919 m, 3.7 mm. **1644-1645**, SEAMOUNT st CP30, 36°44' N, 11°23' W, 1940-2075 m, 3.5 mm and 3.7 mm. **1646**, MONACO Exp st 703, 39°21' N, 31°06' W, 1360 m, 3.5 mm. **1647**, off Frederiksted, West Indies, 4.0 mm. **1648**, DISCOVERY st 9754#3, 51°08' N, 12°01' W, 1484m, 2.1 mm. **1649**, MONACO Exp st 703, 39°21' N, 31°06' W, 1360 m, 1.9 mm. **1650**, WALVIS st DS9, 27°00' S, 01°06' E, 5220 m, 2.0 mm.

The normal bathymetric range is 500-4000 m in the northeastern Atlantic where it is very rare on the continental shelf. Locally it may occur in more shallow water (from 100-150 m) in the Mediterranean and in the northernmost part of its northeastern Atlantic range. Only scattered specimens have been found deeper than 4500 m, down to more than 5500 m.

Benthonella tenella is most common at abyssal depths in the Bay of Biscay, where it accounts for ca 50% of the total number gastropods (live taken specimens and empty shells), and in the western Mediterranean, where it accounts for 83% (Bouchet, unpubl.). In the northwest Atlantic, it accounts for 52.3% of live taken specimens from below 3000 m (Rex & Warén 1982).

Remarks

Nomenclature: Ponder (1985a:36) suggested that *Setia obtusispira* Seguenza, 1876 was probably a synonym of *Benthonella tenella*, but we do not support this view. Ponder was probably influenced by the fact that Nordsieck (1971:fig. 1; 1973:fig. 8) figured under the name "*Putilla obtusispira* (Seguenza)" a shell which certainly is *Benthonella tenella*. For a discussion about the name *S. obtusispira*, see *Obtusella*.

Ponder (1985a:64) also treated *Rissoa amblia* Watson as a synonym of *B. tenella*, but this is a very different species (see p. 677 and Figs 1563-1564, 1570-1572). This synonymy probably results from examination of material erroneously identified as *R. amblia* by Dautzenberg in MOM or IRSN.

B. kullenbergi, from the deep abyssal (5500-5987 m) of the North Atlantic, has a sculpture of numerous closely set axial ribs on the first half teleoconch whorl which become more spaced on the rest of the teleoconch. We have observed a similar sculpture in the few deep abyssal (below 5000 m) specimens available from the Vema fracture zone (10-11° N) and southeastern Atlantic (27-33° S). No adult specimen is available, but they appear to differ from the ribbed form of *B. tenella* from the Azores only in being broader.

Hela conica Seguenza, 1876 (:180) was described as having flattened whorls, deep suture, base indistinctly angulated, umbilical fissure narrow. It was listed as a "Pliocene" fossil from deep-water deposits in Messina, beside *Hela tenella* Jeffreys but, in the absence of type material, it is impossible to properly evaluate this name.

Finally, *B. tenella* var. *costulata* has been claimed several times (Jeffreys 1883a, Sykes 1925) to be the same as *B. margaritifera* (Watson, 1880) from the North Pacific in 3700 m. We lack material from intermediate localities, which is needed to find out whether the distribution is disjunct or continuous. Such material is a prime requisite for evaluating the distinctness of the Pacific population.

Variation. In the area covered by this regional monograph, *B. tenella* presents two distinct morphs with a parapatric distribution:

(1) in the Azores and Madeira the shells are axially ribbed and slender; such specimens correspond to the name *jeffreysi* (= *fischeri*).

(2) along the continent, including the Mediterranean, the shells are smooth and broad. Short axial ribs may be present on scattered shells of *B. tenella* (var. *costulata*) from off Portugal, but they are weak and indistinct and the teleoconch is of the broad type.

We have never seen the two forms in the same dredge haul, except on the banks off southwestern Portugal, where typical *fischeri* and *tenella* forms occur together, mixed with intermediate specimens.

Because the ribbed and smooth groups of populations are very stable throughout a large part of the Northeast Atlantic distribution area, recognition of geographical subspecies and use of trinominal nomenclature may be justified, with *B. tenella tenella* in the northern part of the range, and *B. tenella fischeri* in the southern.

In the western Atlantic, the two forms are also present (and correspond respectively to the names *gaza* and *fischeri*), but the latitudinal differentiation does not parallel that on the European side. The ribbed form occurs off the eastern coast of the United States (see Rex & Etter 1990), while in the Caribbean the ribbed and smooth forms occur together. This pattern may be connected with

the general oceanic circulation in the North Atlantic. We hypothesize that larvae of the *fischeri* form reach the Azores from the western Atlantic via the North Atlantic Drift, while larvae of the smooth *tenella* form reach the Caribbean from the East Atlantic via the North Equatorial Current. Caribbean specimens attain a larger size, up to 8.7 mm, whereas European specimens do not grow larger than 6 mm.

Biology. Benthonella tenella is the most common deep-sea gastropod in the North Atlantic and is one of very few deep-sea gastropods that has been the subject of several non-taxonomical papers. The gross anatomy and morphology of the genital system was described by Ponder (1985a:64, fig. 40).

In populations from abyssal (3806-5042 m) depths in the northwestern Atlantic, developing and mature gametes are found all year round and reproduction appears to be continuous (Rex, Ummersen & Turner 1979).

The protoconch of *B. tenella* indicates planktotrophic larval development. Larvae have been taken in the plankton off Napoli (Richter & Thorson 1975:155, fig. 97 as "unbekannte larvenformen species 1"; Bouchet 1976), off Banyuls (Thiriot-Quiévreux 1969 as 'véligère indéterminée sp.B'), and in the North Atlantic (Scheltema pers. comm. in Bouchet & Warén 1979b). Of 161 larvae caught off Napoli, 63% were taken in the upper 100 m of the water column, and 83% in the upper 200 m. Evidence of ontogenetic migration to surface layers is also supported by stable isotope analysis of the shell carbonates (Killingley & Rex 1985).

Family IRAVADIIDAE

Ponder (1984) revised the family Iravadiidae and included several genera previously placed in the Rissoidae. For the European fauna this concerns *Hyala* and *Ceratia*.

Genus *HYALA* H. & A. Adams, 1852

Hyala H. & A. Adams, 1852:359. Type species, by monotypy, *Turbo vitreus* Montagu, 1803. Europe.

Remarks: The genus contains a single species in Europe (and world wide).

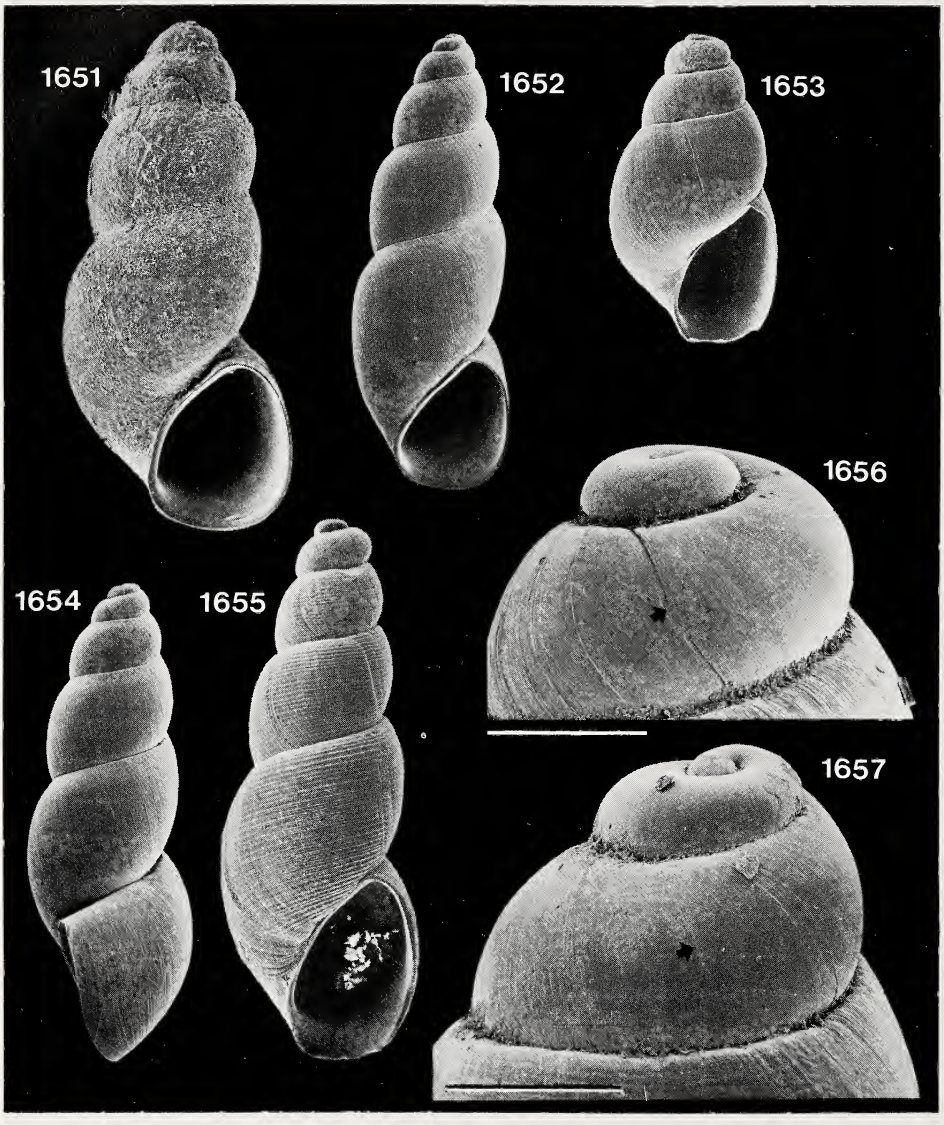
Hyala vitrea (Montagu, 1803) Figs 1651-1654, 1657

Turbo vitreus Montagu, 1803:321.

Type material: 5 syntypes, Royal Albert Memorial Museum, Exeter, no 4211.

Type locality: Whitsand Bay, Cornwall, British Isles.

Material examined: The types and --The Kattegat and the Skagerrak, 20-150 m, 40 samples with 1200 spms; --THALASSA st W353, 43°39' N, 01°56' W, 295 m, 1 spm; st W355, 43°42' N, 01°36' W, 155 m, 39 spms; SARSIA st 7615A, 43°42' N, 03°43' W, 330-340 m, 2 shs; BALGIM st DW28,



Figures 1651-1657. Genera *Hyala* and *Ceratia*. **1651**, *H. vitrea*, Koster Area, Sweden, 3.6 mm. **1652**, *H. vitrea*, Sagres harbour, S. Portugal, 3.8 mm. **1653**, *H. vitrea*, Koster Area, Sweden, young specimen, 1.5 mm. **1654**, *H. vitrea*, Sagres harbour, S. Portugal, 4.1 mm. **1655**, *C. proxima*, Pantellaria, Sicily-Tunisia Channel, 715 m, 3.0 mm (BMNH, coll. Sykes). **1656**, *C. proxima*, Calvi, Corsica. **1657**, *H. vitrea*, Calvi, Corsica.

Scale lines 200 μm.

The arrows indicate the protoconch - teleoconch demarcation.

36°46' N, 07°08' W, 399 m, 1 spm; st DW32, 36°47' N, 07°04' W, 250 m, 1 sh; st DR118, 35°48' N, 05°12' W, 352 m, 1 spm; st DW120, 35°51' N, 05°12' W, 425 m, 12 shs; st DW128, 35°35' N, 03°45' W, 480 m, 1 sh; PORCUPINE Exp 1869, st 2, 51°22' N, 12°25' W, 1470 m, 13 shs (USNM 183747); st 18, 54°15' N, 1109' W, 333 m, 17 shs (USNM 183748); st 18a, (Donegal Bay, Ireland), 45-75 m, 10 shs (USNM 183749); 1870, st 50, Coast of Algeria, 9-93 m, 1 sh (USNM 183766); st Adventure Bank, 167 m, 8 shs (coll. Sykes, BMNH); st Benzert Road, 72-118 m, 1 spm (USNM 183765); -- Corsica, Baie de Calvi, 60-120 m, 10 shs (SMNH); S France, Banyuls, Rech Lacaze, 120-200-270-400-500-650 m, 7 lots, 50 spms.

Distribution: From the British Isles, the Skagerrak and the Kattegat, south to the Ibero-Moroccan Gulf and the Mediterranean, in 25-300 m, occasionally down to 1400 m.

Remarks: Hyala vitrea was listed from western Norway by G.O. Sars (1878), and this record was repeated by Höisaeter (1986:85), but we did not find a single specimen from western Norway in SMNH, ZMC, ZMO or ZMB. Neither did Warén find a single shell during dredgings in the Bergen area (western Norway), which included numerous hauls on the right types of bottoms. Wikander (1989) recorded it from 13 localities along the Norwegian coast of the Skagerrak (21-58 m), but it seems absent from western Norway.

Genus *CERATIA* H. & A. Adams, 1852

Ceratia H. & A. Adams, 1852:359. Type species, by monotypy, *C. proxima* Alder in Forbes & Hanley, 1850. Europe.

Remarks: The genus contains a single European species.

Ceratia proxima (Forbes & Hanley, 1850) Figs 1655-1656

Rissoa striatula Jeffreys, 1847:16 (not *R. striatula* Eichwald, 1830).
Rissoa proxima Alder MS, Thompson, 1847:174 (*nom.nud.*).
? Rissoa pupoides Requien, 1848:56.
Rissoa proxima Forbes & Hanley, 1850:127, pl. 75 figs 7-8 (ex Alder MS).
Rissoa striatissima de Rayneval & Ponzi, 1854:17 (synonymized by Monterosato 1877:35).
Ceratia proxima: Ponder 1984:53.

Type materials: R. striatula, neotype designated by Warén (1980:23), USNM 183132; *R. pupoides*, the Requien collection is in Musée Requien, Avignon, but it does not contain the type of this species (S. Gofas, pers. comm.); *R. proxima* and *R. striatissima*, not located.

Type localities: R. striatula, Cork Harbour, Ireland; *R. pupoides*, Ajaccio, Corsica; *R. proxima*, listed by Forbes & Hanley (1850) from 4 localities on the coast of Ireland; *R. striatissima*, Plio-Pleistocene of Monte Mario, Roma.

Material examined: The neotype of *R. striatula* and --Corsica, Baie de Calvi, 60-120 m, 4 lots, 14 spms (SMNH); S France, Banyuls, Rech Lacaze, 270 m, 1 sh (SMNH); PORCUPINE Exp 1869, st 2, 51°22' N, 12°25' W, 1470 m, 2 shs (USNM 183136); st 18, 54°15' N, 11°09' W, 333 m, 1 sh (USNM 183137); st 18b, Ireland, 1 sh (USNM 183138); PORCUPINE Exp 1870, st 56, 37°03' N, 11°36' W, 710 m, 2 shs (coll. Sykes, BMNH); st Adventure Bank, 167 m, 1 sh (coll. Sykes, BMNH); BAL-

GIM st DW120, 33°51' N, 05°10' W, 425 m, 3 shs; st CP135, 35°26' N, 04°14' W, 395 m, 1 sh.

Distribution: From Ireland to the Mediterranean, usually in 50300m.

Remarks: Ceratia proxima bears some resemblance to *Hyala vitrea* in the shape of the shell and the aperture, but has more convex whorls and a distinct spiral striation. It resembles more closely certain specimens of *Onoba aculeus*, but that species has a swollen protoconch of less than one whorl (Fig. 1488) and an aperture (Fig. 1507) which is evenly rounded in its lower part, not truncated as in *C. proxima*.

Ceratia proxima has frequently been recorded from Scandinavia, but every museum lot we have examined contained weakly sculptured specimens of *Onoba aculeus*, and we never found a single shell ourselves.

Family ELACHISINIDAE

The family was introduced by Ponder (1985b) for a group of mainly shallow-water species differing from the Rissoidae in anatomical features.

Genus *LAEVIPHITUS* van Aartsen, Bogi & Giusti, 1989

Laeviphitus van Aartsen, Bogi & Giusti, 1989:19. Type species, by original designation, *L. verduini* van Aartsen, Bogi & Giusti, 1989. Mediterranean.

Remarks: Laeviphitus was originally placed in the Epitoniidae by its authors, but we can see very little similarity with that family. The protoconchs of the Nystiellinae have a somewhat similar cancellate sculpture, but are tall and conical, consisting of 2.5-4 whorls (Figs 1131-8). The teleoconch and especially the aperture, is more similar to the Elachisinidae, where we have chosen to place *Laeviphitus*.

Laeviphitus verduini van Aartsen, Bogi & Giusti, 1989 Figs 1658-1660

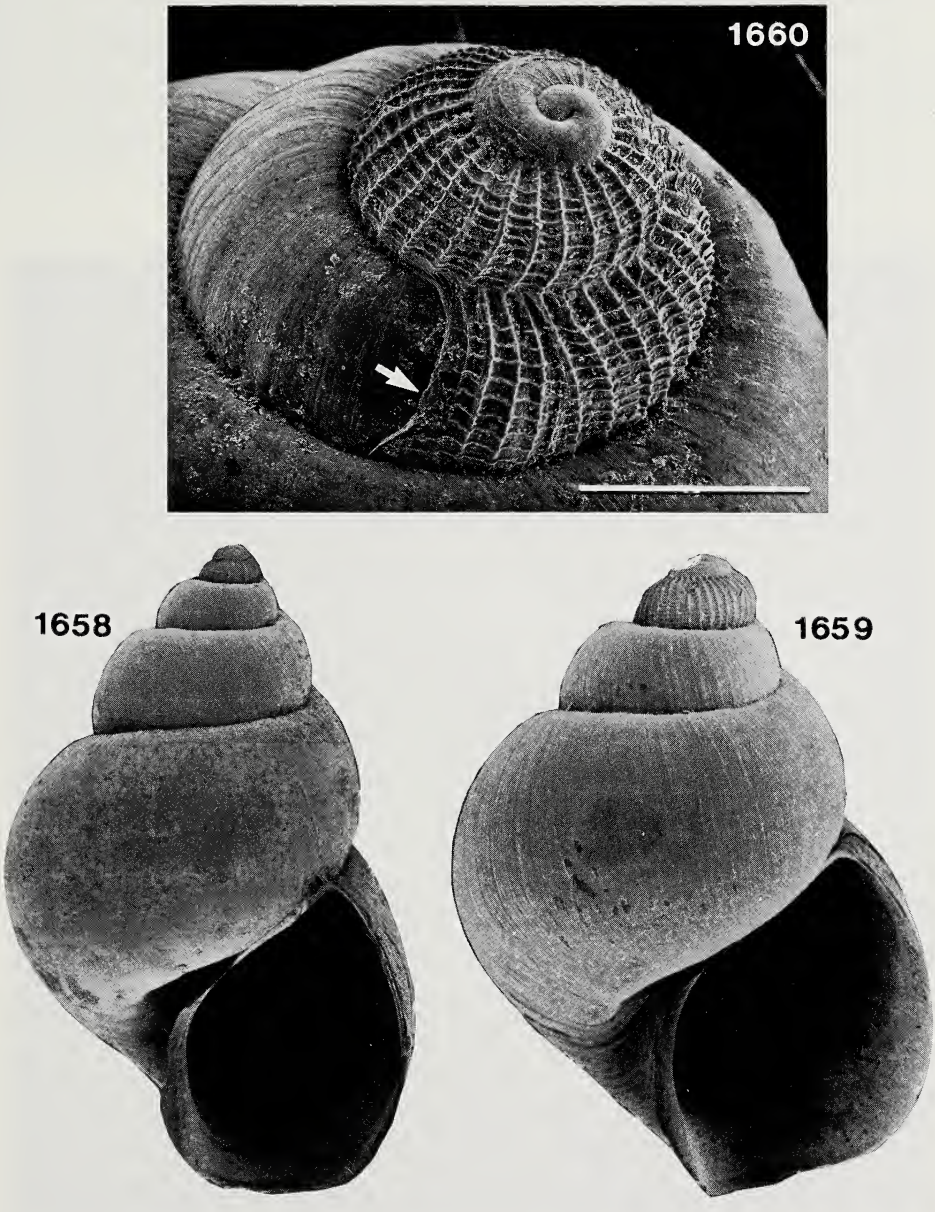
Laeviphitus verduini van Aartsen, Bogi & Giusti, 1989:19, figs 1-4.
Elachisina versiliensis Warén, Carrozza & Rocchini, 1990:337, figs 1B-D, 2.

Type materials: L. verduini, holotype in Museo di Zoologia, Bologna, no 7663; *E. versiliensis*, holotype SMNH 4113.

Type localities: L. verduini, Southwest of Capraia, Tuscan archipelago, Tyrrhenian Sea, 320-440 m; *E. versiliensis*, between Italy and Corsica, 300-400 m.

Distribution: Off western Italy, the Tuscan archipelago and Tyrrhenian Sea, 300-400 m; larvae known from Ischia, off Napoli, southern Italy.

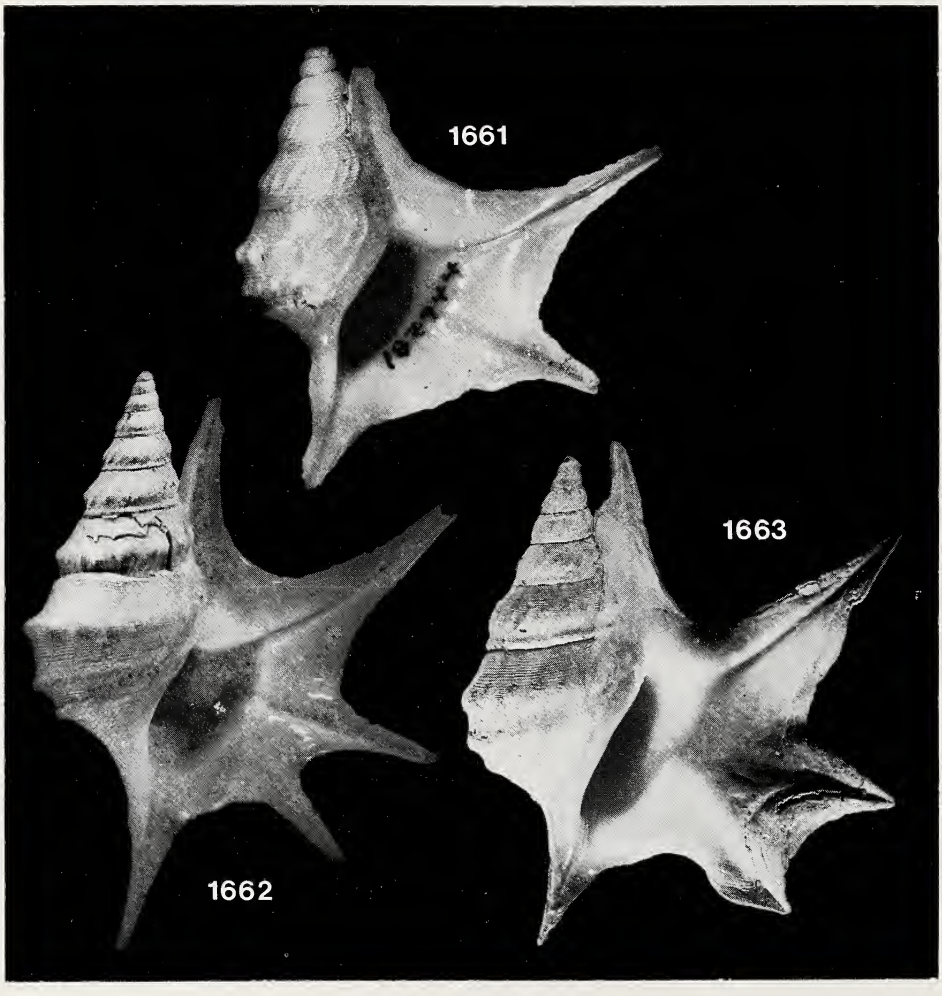
Remarks: The present species was known from its larvae before the adult stage was described. It was figured by Richter & Thorson (1975:fig. 98) as "unbekannte larvenform 2", from Golfo di Napoli.



Figures 1658-1660. *Laeviphitus verduini*. **1658**, holotype of *Elachisina versiliensis*, 3.9 mm. **1659**, halfgrown specimen, 1.7 mm. **1660**, protoconch, scale line 200 μm. The arrow indicates the protoconch - teleoconch demarcation.

Nothing is known about this species and adult specimens are known exclusively from empty shells.

Laeviphitus verduini has an overall resemblance to *Benthonella tenella* (Figs 1636-8), but the latter has a very different larval shell with only spiral sculpture.

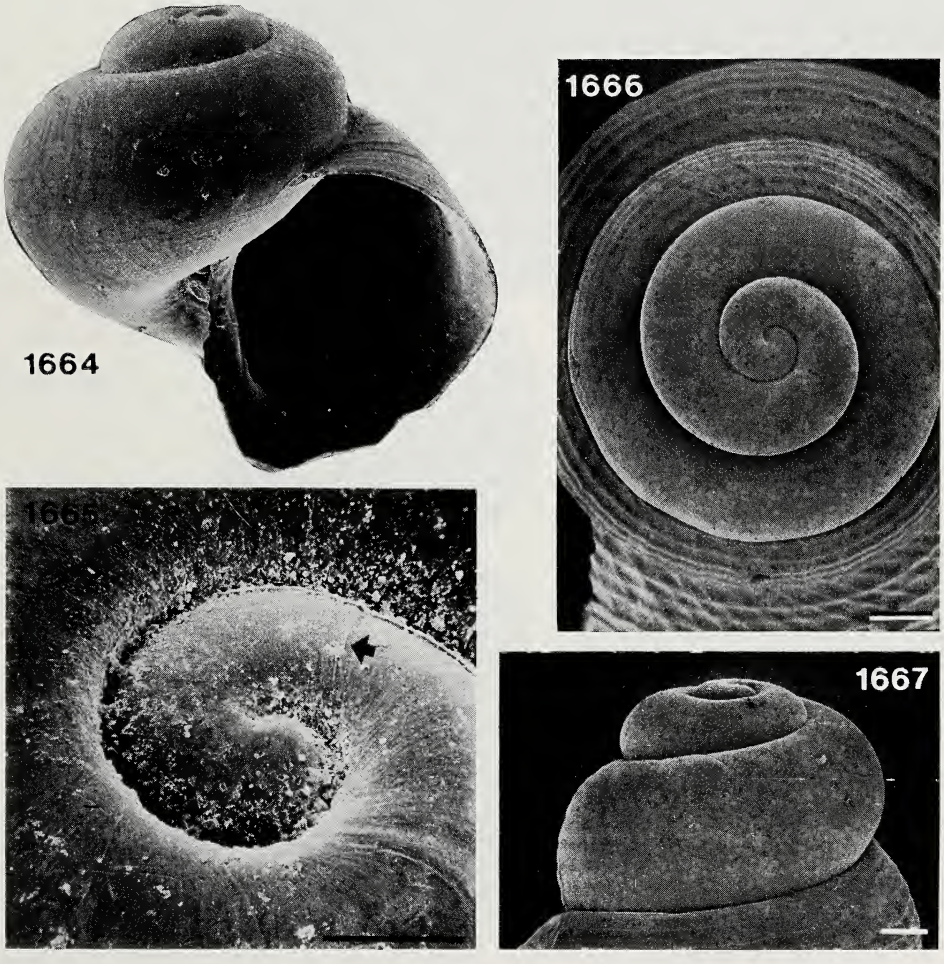


Figures 1661-1663. *Aporrhais serresianus*. **1661**, Shetland, 20.5 mm (USNM 187944, Jeffreys collection). **1662-1663**, Bergen area, 43 and 36 mm.

Family APORRHAIDAE

Genus *APORRHAIS* da Costa, 1778

Aporrhais da Costa, 1778:136. Type species, by monotypy, *A. quadrifidus* da Costa, 1776 (= *Strombus pespelicani* Linné, 1758). Europe.
Chenopus Philippi, 1836:214. Type species, by subsequent designation (Gray 1847b:136), *Strombus pespelicani* Linné, 1758. Europe.
Arrhoges Gabb, 1868:145. Type species, by monotypy, *Rostellaria occidentalis* Beck, 1836. Northwestern Atlantic.
Pelecanus Piette, 1876:265 (not Linné, 1758). Type species not designated.



Figures 1664-1667. *Aporrhais serresianus*, protoconch. **1664**, newly settled larva, 1.5 mm. **1665**, protoconch I of the same specimen, scale line 100 μm. The arrow indicates the protoconch I - protoconch II demarcation. **1666-1667**, apex, apical and side view, 43°37' N, 02°08' W, 480-1500 m, scale lines 200 μm.

Remarks: The East Atlantic species of *Aporrhais* were reviewed by Cosel (1977).

The name *Ornitopus* Piette, 1891:504 (replacement name for *Pelecanus* Piette, 1876:265) still remains an available generic name for *A. pespelicani* since the name was included among the three(!!) species originally listed as types by Piette, and no subsequent designation of a type species seems to have been done.

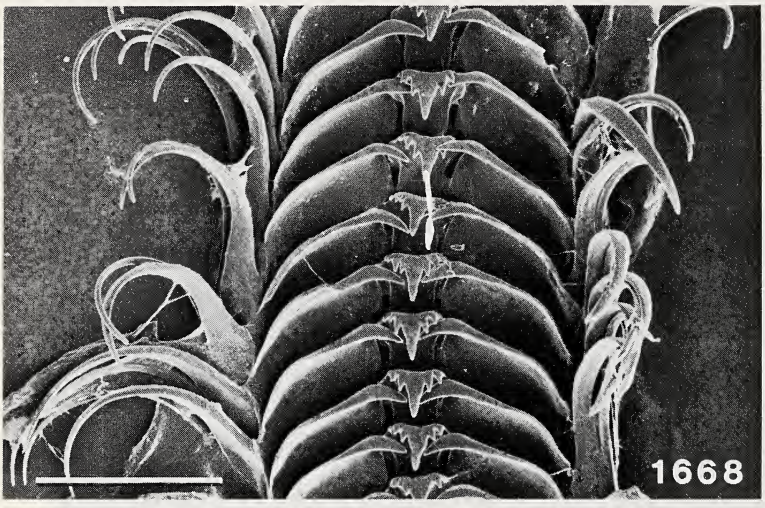


Figure 1668. *Aporrhais serresianus*, radula, Korsfjord, Norway, scale line 200 μm.

Aporrhais serresianus (Michaud, 1828) Figs 1661-1668

Rostellaria serresiana Michaud, 1828:120, figs 3-4.
Aporrhais macandreae Jeffreys, 1867:253, pl. 80 fig. 2.
Aporrhais serresianus vars *minor, crassa, ventricosa* Locard, 1890:10-11.
Aporrhais pespelecani sarsii Kobelt, 1908:17, pl. 102 figs 3-4 (based on Sars 1878:pl. 22 fig. 7).
[not *Aporrhais michaudi* Locard, 1890:11 = *A. pespelicani*].

Type materials: R. serresiana, not known; *A. macandreae*, 2 syntypes USNM 187883, 1 syntype SMNH; *A. pespelecani sarsii*, presumably in ZMO.

Type localities: R. serresiana, off Barcelona, Spain; *A. macandreae*, 6-50 miles east of Shetland, 72-154 m; *A. pespelecani sarsii*, presumably in Norway.

Material examined: 110 lots with 850 spms, from all parts of the distributional area.

Distribution: From southern Iceland and Lofoten, northern Norway, southwards along the European coast and the Mediterranean, south to off northwestern Morocco, usually in 200-1000 m.

Remarks: Aporrhais serresianus may resemble certain forms of *A. pespelicani*, but may be distinguished by its finer sculpture and less solid shell.

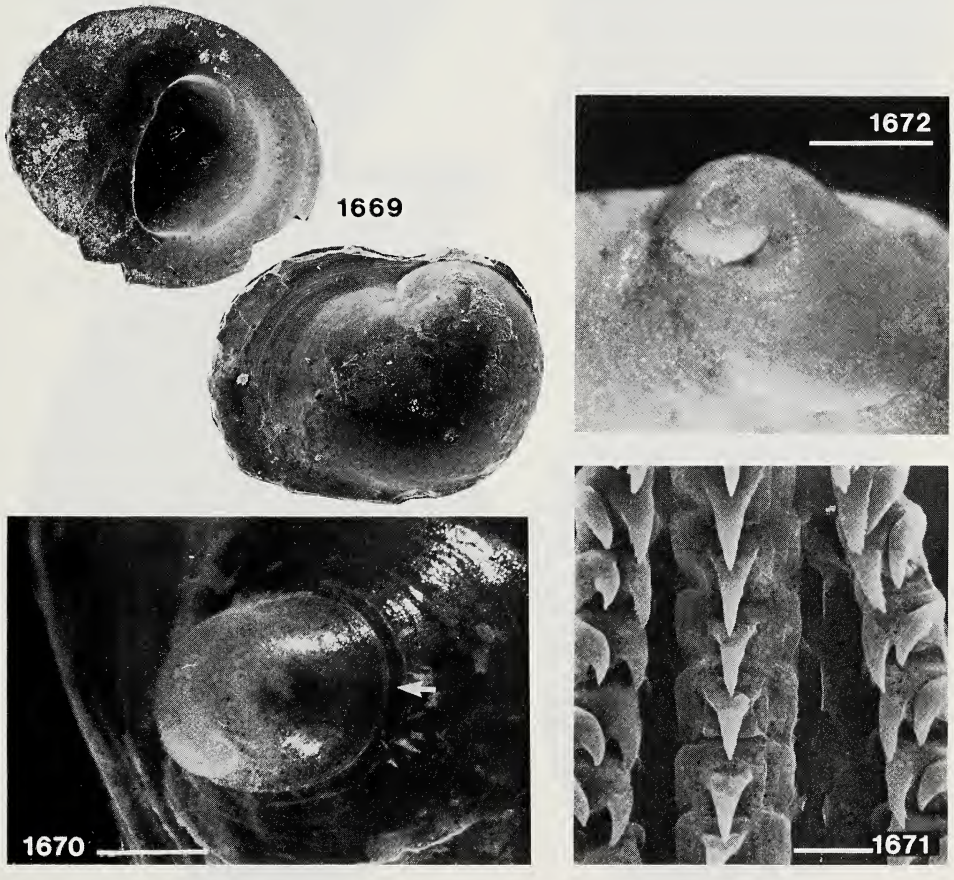
Some observations on living animals were published by Yonge (1937) and Barnes & Bagenal (1952). Thiriot-Quivreux (1976) described the veliger which has planktotrophic development and we figure a recently settled larva (Fig.1664). The reproduction is thus probably similar to what Thorson (1946) described for *A. pespelicani*, which also has planktotrophic development.

The name *Rostellaria pescarbonis* Brongniart, 1823, has occasionally been used for *A. serresianus*, but this is an Italian Eocene fossil from Ronca.

Family HIPPONICIDAE

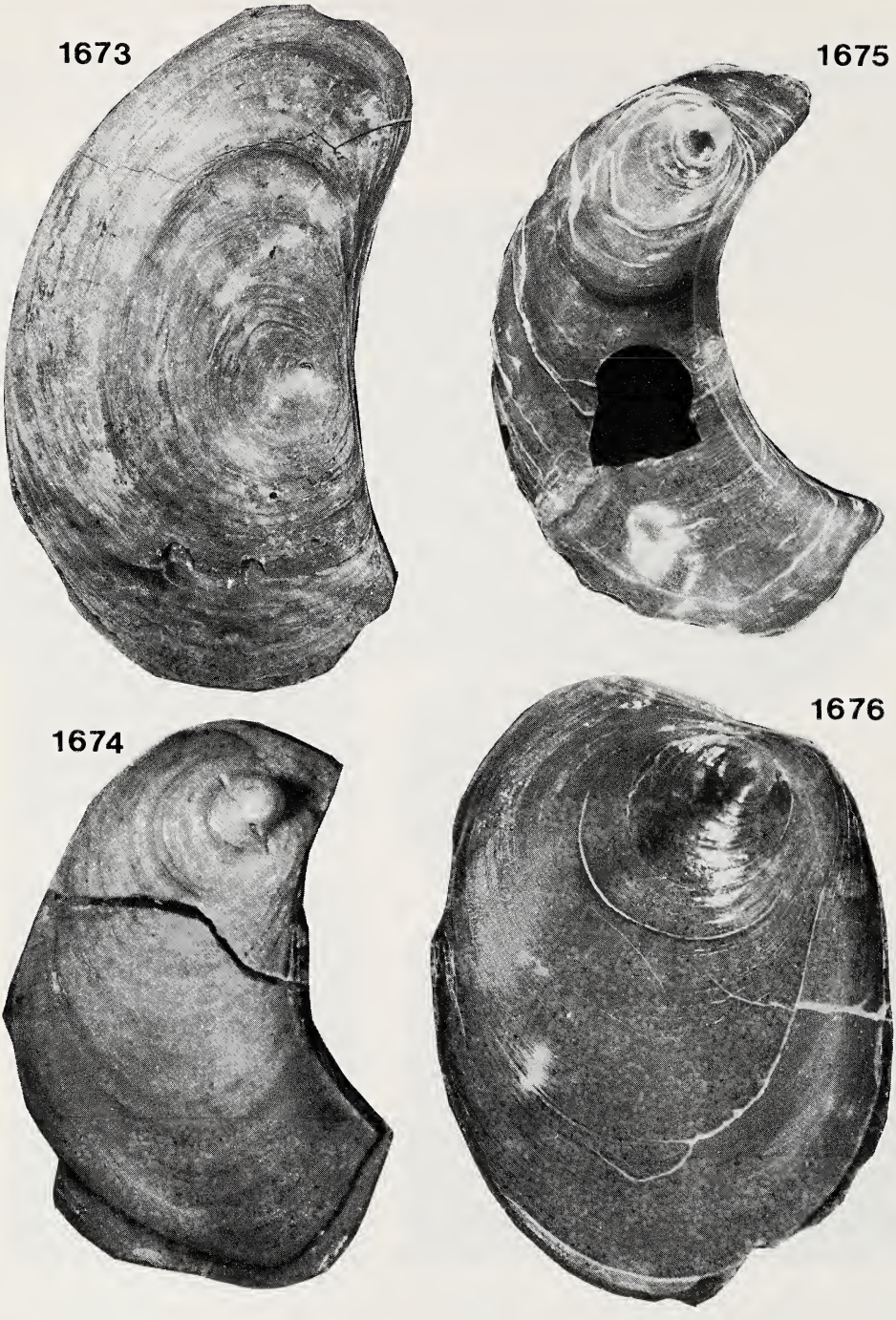
The family Hipponicidae contains numerous species, usually with a limpet-shaped shell. They are sedentary forms which often produce a calcareous coating on the shell or rock they are sitting attached to, almost forming a second shell. They are ciliary feeders and some species live in close association with other animals, like some species of *Malluvium* Melvill, 1906, which may live on spines of cidaroid sea urchins.

Hipponicids are fairly common on the upper part of the continental slope, down to more than 2000 m. In the North Atlantic they are sparsely represented and in the area covered by this series, we have found only a single species.

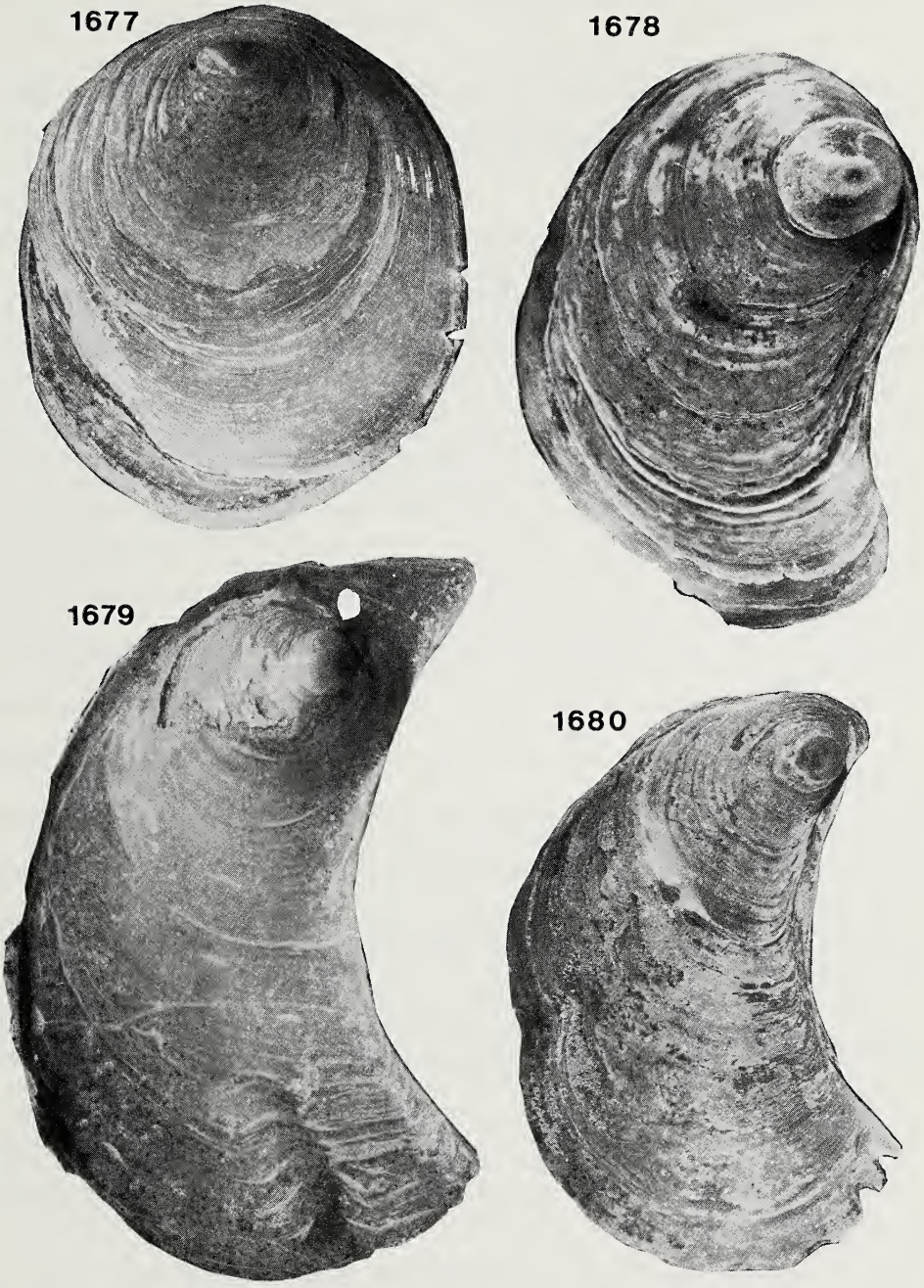


Figures 1669-1672. Genus *Leptonotis*. **1669**, *L. perplexus*, Western Australia, 16°56' S, 119°52' E, 400-436 m, diameter 2.0 mm (WAM 1752-84). **1670-1671**, *L. perplexus*, TRAVAILLEUR 1882 dr 1. The arrow indicates the protoconch - teleoconch demarcation. **1672**, *L. squamaeformis*, Eocene of Villiers, Paris Basin.

Scale lines 0.5 mm (1670, 1672), 20 μm (1671).



Figures 1673-1676. Genus *Leptonotis*. **1673**, *L. squamaeformis*, Eocene of Barton, Great Britain, 36.5 mm. **1674**, *L. perplexus*, possible syntype of *Atlanta fossilis*, Eocene of Cape Otway, Victoria, Australia, 8.5 mm. **1675**, *L. perplexus*, CANCAP st 5.042, 12.4 mm. **1676**, *L. perplexus*, TRAVAILLEUR 1882 dr 1, diameter 5.4 mm.



Figures 1677-1680. *Leptonotis perplexus*. **1677**, Western Australia, 16°56' S, 119°52' E, 400-436 m, 18.2 mm (WAM 1752-84). **1678**, New Zealand, 41°30.5' S, 174°54' E, 630-650 m, 11.5 mm. **1679**, Philippines, MUSORSTOM 2 st CP55, 13°54' N, 119°58' E, 865 m, 11.5 mm. **1680**, same data as fig. 1678, 16 mm.

Genus *LEPTONOTIS* Conrad, 1866

Leptonotis Conrad, 1866:265. Type species, by monotypy, *Velutina expansa* Whitfield, 1865. Eocene, eastern United States.
Neojanacus Suter, 1907:266. Type species, by original designation, *N. perplexus* Suter, 1907. New Zealand. (***Syn. nov.***).

Remarks: The genus *Leptonotis* has until now been considered a synonym of *Capulus* (see e.g. Wenz 1940:897), whereas *Neojanacus* was placed in Calyptraeidae.

The description of *Velutina expansa*, the type species of the genus, was based on a very young specimen of a species, which we find indistinguishable from *L. squamaeformis*, from the Eocene of the Paris Basin. Conrad's comment that it was found inside other shells contributes to the credibility of this identification, since also *L. squamaeformis* is found in this way (LeRenard, pers. comm.).

The only easily observable character we have found useful for specific distinction is the larval shell. The teleoconch is a simple calcareous plate which takes its shape after the shell it inhabits. The protoconch of *L. perplexus* (Figs 1669-70) is paucispiral and limpet-like despite an internal coiling of about half a whorl. It is very similar to that of species of *Malluvium* (see Dell 1964:figs 96-97, as *Capulus calcareus*). *L. expansus* and *L. squamaeformis* (Fig. 1672) have a normally coiled, globular larval shell which indicates planktotrophic larval development. This larval shell is also very similar to that of many hipponicids with planktotrophic development.

In order to get an overview of *Leptonotis*, we have compiled a list of the names described in the genus, together with additional species we have noticed as belonging there:

--*Patella squamaeformis* Lamarck, 1803. Type locality Paris Basin, Eocene. Material from coll. LeRenard examined. (Figs 1672-1673).

--*Velutina ("Otina") expansa* Whitfield, 1865. Type locality Prairie Bluff, Alabama, Eocene (from "sand filling the cavities of other shells").

--*Capulus complectus* Aldrich, 1886. Type locality Alabama, Eocene. [= *C. expansus* Whitfield *fide* Palmer & Brann 1966].

--*Atlanta fossilis* Tate, 1898. Type locality Cape Otway, Victoria, Australia, Eocene. Possible syntype SAM T343 examined (Fig.1674).

--*Neojanacus perplexus* Suter, 1907. Type locality, see below. Several recent specimens from New Zealand examined (Figs 1678, 1680).

--*Neojanacus kaawaensis* Bartrum & Powell, 1928. Type locality Kaawa Creek, New Zealand, Opoitian (Pliocene). We agree with Maxwell (1988) that this species more likely belongs to the Calyptraeidae.

--*Neojanacus wharekuriensis* Laws, 1935. Type locality Warekuri, New Zealand, Duntronian (Oligocene). Not examined. Synonymized with *N. perplexus* by Maxwell (1988).

--*Capulus planus* Dockery (*in* McNeil & Dockery), 1984. Type locality Missisippi, lower Oligocene.

The animal of *Leptonotis perplexus* does not possess a pseudoproboscis, as all species of Capulidae do. Instead it has a very small head with a slender, long neck and minute, laterally placed tentacles (Dell 1956:fig. 100, and personal observations). It is evidently a highly modified animal, as also the radula (Fig. 1671) indicates, and little emphasis should be paid to radular characters for discussing its systematic position.

Species of *Leptonotis* live inside large gastropod shells, usually inhabited by a hermit crab. The shell is often attached close to the columella of the host shell, which accounts for the peculiar, semicircular shape of many specimens (Figs 1675, 1679). We have examined about a dozen adult females, from the northeastern Atlantic, New Zealand, the Philippines and Western Australia. They almost always occur together with one to several much smaller males.

It can safely be assumed that the species of *Leptonotis* are ciliary feeders, as has been described by Yonge (1953, 1960) for *Hipponix antiquatus* (Linné, 1758).

From the similarity in the larval shell, both of species with plankto- and lecithotrophic development, in the shape of the animal and in the biological similarities, we conclude that *Leptonotis* should be placed in the family Hipponicidae.

Leptonotis perplexus (Suter, 1907) Figs 1669-1671, 1675-1680

Neojanacus perplexus Suter, 1907:266.
Neojanacus perplexus: Dell 1956:71, figs 98-102.
Neojanacus perplexus: Maxwell 1988:48, pl. 4 figs p-q.

Type material: Supposed to be in NMNZ (not examined).

Type locality: off Great Barrier Island, New Zealand, 200 m.

Material examined:
--New Zealand: several shs and spms (NMNZ).
--Western Australia: West off Lacépède Archipelago, 350-450 m, 10 females and several males from *Fusinus* sp., inhabited by hermit crabs (WAM 1752-84, 1627-84).
--The Philippines: MUSORSTOM 2 st CP55, 13°54' N, 119°58' E, 865 m, 1 female in a shell inhabited by a hermit crab (MNHN).
--Northeast Atlantic: SEAMOUNT st CP30, 36°44' N, 11°23' W, 1940-2075 m, 1 sh; st CP50, 36°37.4' N, 14°31.7' W, 1360-1380 m, 1 female, 1 male in *Kryptos koehleri*; CANCAP st 5.042, 36°50' N, 24°42' W, 2775 m, male and female, in a turrid shell; BALGIM CP18, 36°48' N, 09°21' W, 1544-1612 m, 1 female in *Amauropsis brassiculina* (left in position); BALGIM st CP95, 32°24' N, 07°39' W, 1378 m, 1 sh; TRAVAILLEUR 1882 dr 1, 44°17' N, 05°32' W, 564 m, inside holotype of *Natica olivella*, male and female.

Distribution: Uncertain, see discussion.

Remarks: We have not been able to find any persistent differences between our specimens from different geological times and widely separate localities, except that the two Eocene species *L. squamaeformis* and *L. expansa*, are based on a species with multispiral larval shell (Fig. 1672), while all the more recent (Oligocene to Recent) species have a paucispiral one. Individuals evidently take their shape after the gastropod shell they live inside and are exceedingly variable. We figure two specimens (Figs 1675-6) from a restricted part of the North Atlantic, therefore probably belonging to a single species, to contrast with Figs 1673-80, which cover a geographical area from New Zealand to Europe, and the time from Eocene to Recent.

This variability has made it impossible to distinguish between the names listed above and we have kept the name given to the Recent species from New Zealand, although the name *Atlanta fossilis* (for some unexplicable reason, described as the operculum of *Atlanta*) is nine years older. We do not, however, say that they necessarily belong to the same species, only that we cannot distinguish them.

Family VANIKORIDAE

The family Vanikoridae was first recognized in the European fauna by Warén & Bouchet (1988), who reviewed the European shallow water species. From examination of worldwide deep-water collections, vanikorids appear to occur regularly in deep shelf and slope faunas of the temperate and tropical regions. From the northeastern Atlantic we know two species. We refer to Warén & Bouchet (1988) and Warén (1989a) for a discussion of the genera treated here.

Genus *TALASSIA* Warén & Bouchet, 1988

Talassia Warén & Bouchet, 1988:93. Type species, by original designation, *Rissoa coriacea* Manzoni, 1868. Madeira.

Remarks: Four nominal taxa of the European fauna belong to *Talassia*, of which two have been described from rather shallow water in Madeira, the others from the continent. It is, however, not clear how many species are involved. No species of *Talassia* is known from the seamounts between southwestern Portugal and Madeira, and for this reason we will provisionnally treat the Madeiran and European species as distinct species. Obviously the problem needs to be reconsidered when good samples from Madeira become available.

Talassia dagueneti (de Folin, 1873) Figs 1681-1700, 1702-1703

Salassia dagueneti de Folin, 1873:112, pl. 3 fig. 2.
Auriconoba continentalis Nordsieck, 1974a:11, figs 5. (***new synonym***).

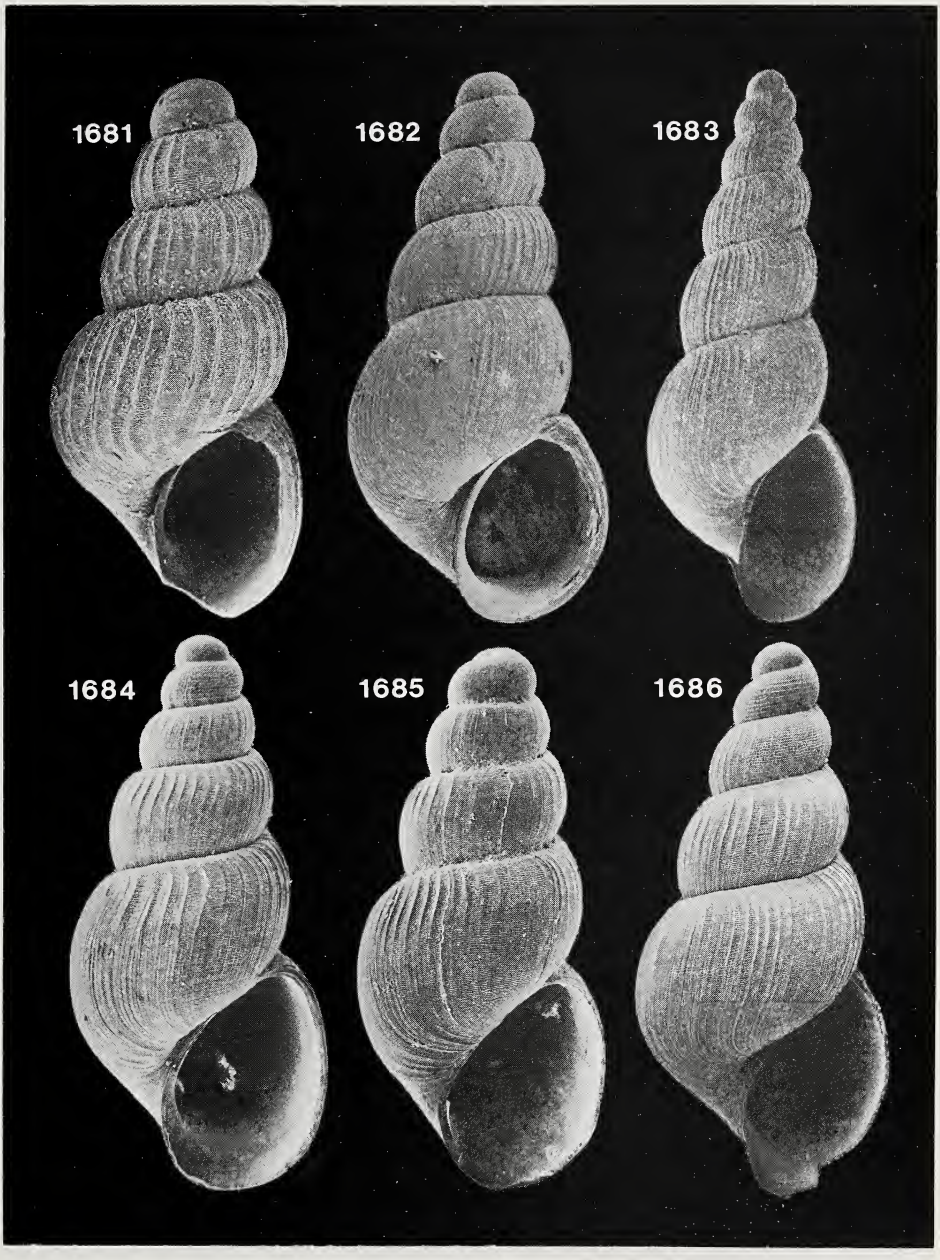
Type materials: S. dagueneti, 2 syntypes in MNHN; *A. continentalis*, syntypes probably in the collection of F. Giannini, Italy.

Type localities: S. dagueneti, fosse de Cap Breton, southeastern Bay of Biscay; *A. continentalis*, off Capo Comino, Sardinia, 200-220 m.

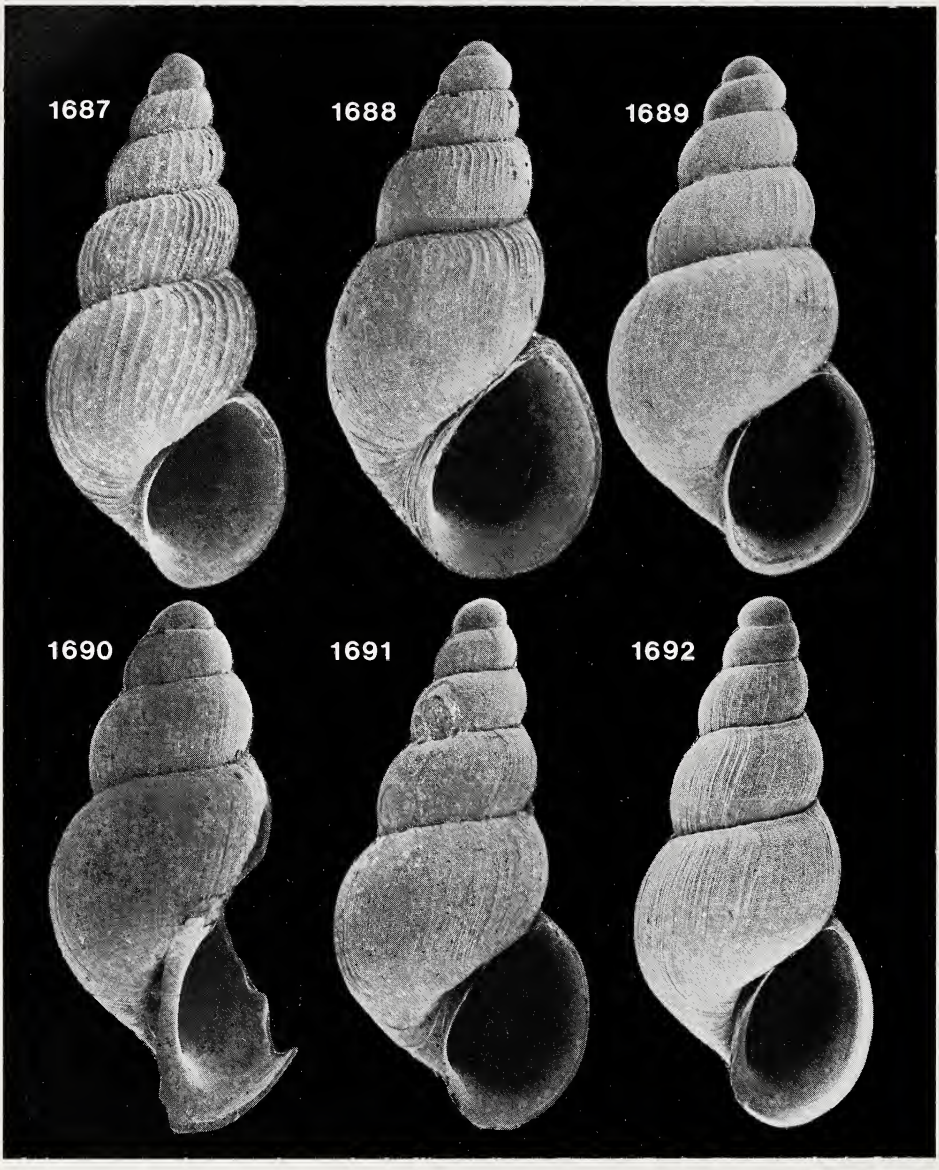
Material examined: The type material of *S. dagueneti* and:

Mediterranean: --BALGIM st DW132, 35°26' N, 04°19' W, 170 m, 4 shs; st DW134, 35°26' N, 04°17' W, 205 m, 1 sh; PORCUPINE Exp 1870 st 53, 36°53' N, 05°55' W, 205 m, 1 sh (USNM 183307); Algeria, 95 m, 3 shs (BMNH); Adventure Bank, 170 m, 23 shs (BMNH, USNM 183306); Pantellaria, 715 m, 15 shs;

Atlantic: PORCUPINE Exp 1870 st 9, 48°06' N, 09°18' W, 990 m, 3 shs (USNM 183294); st 16, 39°55' N, 09°56' W, 1809 m, 3 shs (USNM 183299); st 17-17a, 39°39' N, 09°39' W, 1092-1993 m, 33 shs (BMNH, USNM 183300); st 24, 37°19' N, 09°13' W, 535 m, 9 shs (BMNH, USNM 183301); st 26, 36°44' N, 08°08' W, 670 m, 2 shs (USNM 183302); st 36, 35°35' N, 06°26' W, 133-235 m, 4 shs (BMNH, USNM 183303); Cap Breton, Bay of Biscay, 1 sh (coll. Jeffreys ex de Folin, USNM 183295); TRAVAILLEUR 1880 dr 2, 43°36' N, 01°55' W, 1025 m, 2 shs; TRAVAILLEUR Exp, no data, 2 shs (USNM 183308); Cabo Penas, Spain, 1 sh (USNM 183298); THALASSA st X363, 44°06' N, 04°53' W, 545-630 m, 2 shs; st Y401, 40°37' N, 09°22' W, 1040 m, 1 spm; st Y405, 40°33' N, 09°27' W, 1170 m, 1 sh, 1 spm; BALGIM st DR23, 36°39' N, 07°19' W, 556 m, 1 sh; st DR40, 35°50' N, 06°09' W, 362 m, 7 shs; st DW50, 35°53' N, 06°32' W, 518-526 m, 7 shs; st DW57, 35°42' N, 06°35' W, 548 m, 1 sh; st DW88, 34°20' N, 07°19' W, 738-742 m, 1 sh; st CP91, 34°22' N, 07°25' W, 948 m, 1 spm; st CP92, 34°24' N, 07°30' W, 1182 m, 1 spm, 3 shs; st DW128, 35°35' N, 03°45' W, 480 m, 1 sh;



Figures 1681-1686. *Talassia dagueneti*. **1681**, THALASSA, off the Iberian Peninsula, 1.6 mm. **1682**, TRAVAILLEUR 1880 dr 2, 2.3 mm. **1683**, THALASSA st Y405, 3.6 mm. **1684**, Adventure Bank, Sicily-Tunisia Channel, 2.5 mm. **1685**, Pantellaria, Sicily-Tunisia Channel, 715 m, 1.8 mm (BMNH, coll. Sykes). **1686**, CANCAP st 4.086, 2.3 mm.



Figures 1687-1692. *Talassia dagueneti*: variation in the Ibero-Moroccan Gulf. **1687**, BALGIM st DW128, 2.8 mm. **1688**, BALGIM st DW57, 2.4 mm. **1689**, BALGIM st CP91, 2.4 mm. **1690**, BALGIM st DR23, 2.1 mm. **1691**, BALGIM st CP92, 2.9 mm. **1692**, CINECA st B31, 2.8 mm.

CANCAP st 2.058, 27°58' N, 13°15' W, 500 m, 1 sh; st 2.079, 28°01' N, 14°26' W, 870 m, 1 sh; --st 3.068, 30°07' N, 15°53' W, 310 m, 1 sh; st 4.077, 28°47' N, 13°37' N, 1085 m, 1 sh; st 4.086, 28°54' N, 13°33' W, 785 m, 1 sh; CINECA st B31, 29°36' N, 11°04' W, 1500 m, 2 shs.

Distribution: From the southern part of the Bay of Biscay to Morocco and into the Mediterranean as far east as the Sicilian Channel, in 150-2000 m. The record from PORCUPINE Exp st 9 may result from erroneous labelling and is considered doubtful because no other expedition has taken the species in the northern part of the Bay of Biscay.

Remarks: This is the species recorded in the literature on Mediterranean molluscs as *Rissoa tenuisculpta* (Watson, 1873). Nordsieck (1974a, 1982) was mistaken when suggesting affinities to *Lanzaia elephantota*, which is a freshwater hydrobiid from Yugoslavia!

Specimens from the same sample are not very variable and are certainly always conspecific. This, in combination with non-planktotrophic development (inferred from the protoconch), could be an indication that much of the character variation observed between samples is intraspecific. The variation is however difficult to understand, especially in the Atlantic, because it does not appear to follow any pattern. A single variable species or several less variable ones might be involved.

When one considers material from a restricted geographical area (Ibero-Moroccan Gulf, from the BALGIM cruise) it seems, however, that material from intermediate depths is also intermediate in characters. The specimen from BALGIM st CP91 (948 m) (Figs 1689, 1694) has a sculpture of weak axial ribs that is intermediate between the shell from st DW128 (480 m) (Figs 1687, 1698) with strong axial ribs and the shells from st CP92 (1182 m) (Figs 1691, 1697) which are almost devoid of axial sculpture. A part of the variation could thus be depth-related. Shells from the northern part of the distribution tend to be more slender, with high spire and strong sculpture (Figs 1681-3).

In the Mediterranean, *Talassia dagueneti* tends to be less variable. Mediterranean specimens (Figs 1684-5) generally have convex whorls with a deep, almost channelled, suture, giving the shell a slightly scalariform appearance. The sculpture consists of strongly curved axial riblets, most prominent below the suture and disappearing towards the middle of the whorl. The aperture is proportionally broader than usual in Atlantic populations. Mediterranean shells resemble small specimens of *T. coriacea* (Manzoni, 1868) (Figs 1701, 1704), which have a similar sculpture of curved axial ribs that fade at mid-whorl, and have a similarly channelled suture. *Talassia coriacea* is, however, much larger and broader than *T. dagueneti* and lives in more shallow water, ca 30-60 m.

Talassia tenuisculpta (Watson, 1873) (syntypes examined, BMNH) resembles specimens from deep water in being more slender than *coriacea*, but *tenuisculpta* has a weaker sculpture.

Genus *LARSENIA* Warén, 1989

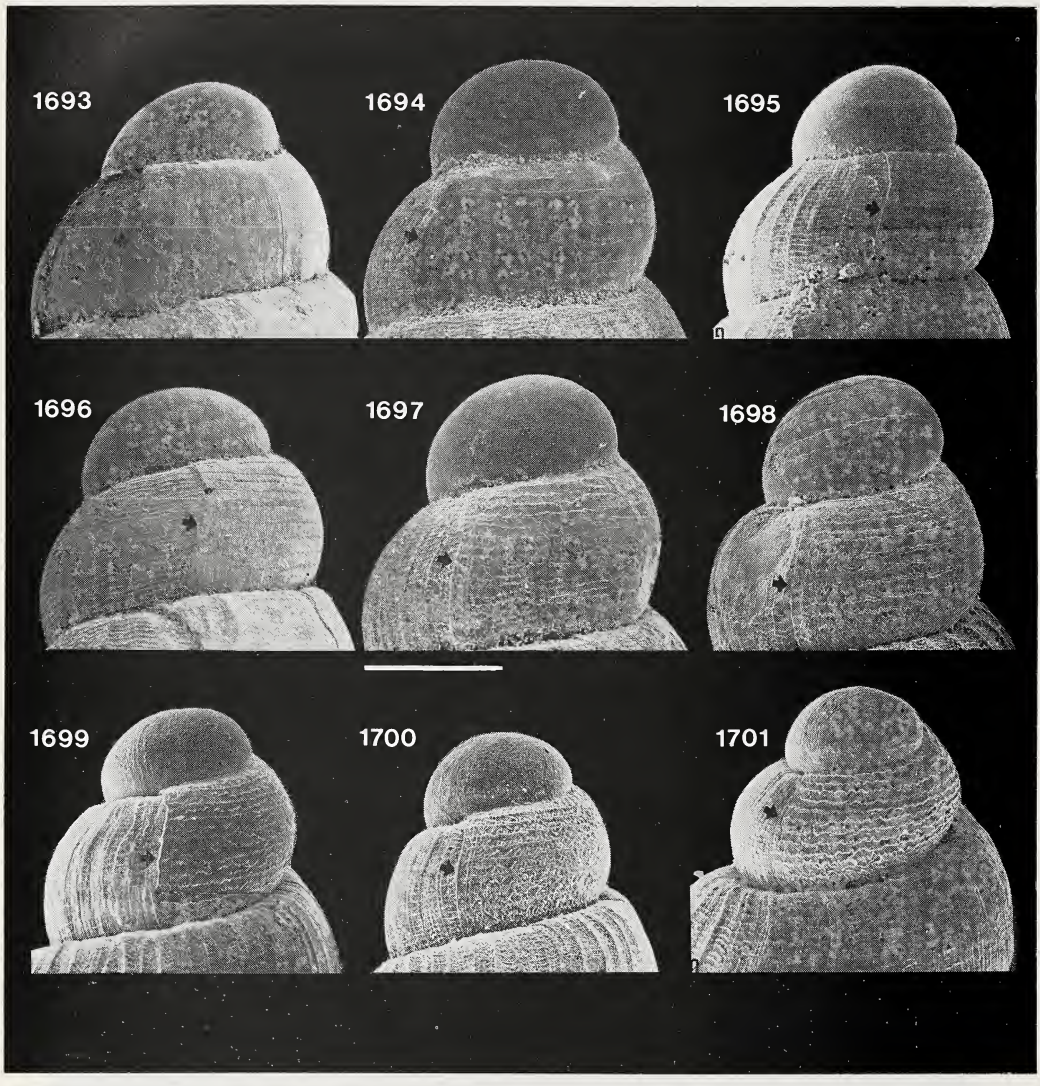
Larsenia Warén, 1989a:14. Type species, by original designation, *Larsenia scalaroides* Warén, 1989. Iceland.

Larsenia scalaroides Warén, 1989 Figs 1705-1707

Larsenia scalaroides Warén, 1989a:14, figs 9E-G.

Type material: Holotype SMNH 3899, paratypes in Natural History Museum, Reykjavik, coll. H. Larsen, Reykjavik, SMNH and MNHN.

Type locality: Jökultunga, southwestern Iceland, 260-300 m.



Figures 1693-1701. Protoconchs of *Talassia*. **1693-1700**, *Talassia dagueneti*, variations of protoconch sculpture. **1693**, BALGIM st DR23. **1694**, BALGIM st CP91. **1695**, THALASSA st Y405. **1696**, TRAVAILLEUR 1880 dr 2. **1697**, BALGIM st CP92. **1698**, BALGIM st DW128. **1699**, Adventure Bank, Sicily-Tunisia Channel, 170 m. **1700**, BALGIM st DR40. **1701**, *T. coriacea*, Madeira.

Scale lines 200 μm.

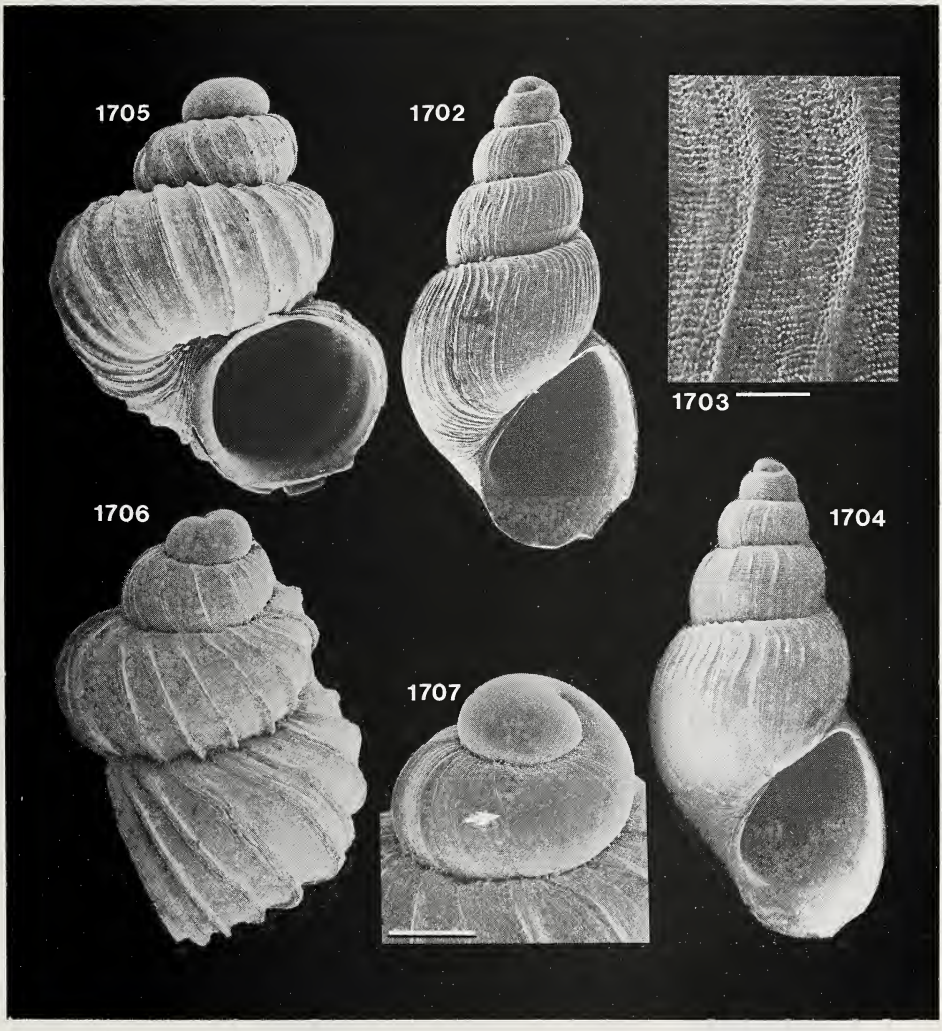
The arrows indicate the protoconch - teleoconch demarcation.

Material examined: The material listed by Warén (1989a).

Distribution: Southeastern Greenland to western and southern Iceland, in 200-900 m.

Remarks: We do not know any North Atlantic gastropod which invites to confusion with *Larsenia scalaroides*. The archaeogastropod genus *Vetulonia* Dall, 1913 has a superficial resemblance, but the shell is more depressed and the body whorl shows no trace of disjunct coiling.

The protoconch indicates non-planktotrophic larval development.



Figures 1702-1707. Genera *Talassia* and *Larsenia*. **1702**, *Talassia dagueneti*, syntype, 2.3 mm. **1703**, *T. dagueneti*, Adventure Bank, detail of microsculpture; scale line 50 μm. **1704**, *T. coriacea*, Madeira, 2.8 mm (ZMC). **1705-1706**, *Larsenia scalaroides*, holotype (fig. 1705), 1.9 mm and paratype (fig. 1706), 2.2 mm. **1707**, *L. scalaroides*, protoconch; scale line 200 μm. The arrow indicates the protoconch - teleoconch demarcation.

Family HALOCERATIDAE

The family Haloceratidae was described and monographed recently (Warén & Bouchet 1991), and we will here only summarize the taxonomic conclusions concerning the northeast Atlantic species. For anatomical description and further illustrations of shells, protoconchs and radulae, we refer to the revision of the family. Haloceratidae can be recognized by their multispiral protoconch (Figs 1720-5), sculptured with 2-3 spiral keels and the teleoconch with depressed or angular whorls. In the northeastern Atlantic only *Benthonella tenella* has a protoconch resembling that of haloceratids.

Six species are present in the northeastern Atlantic.

KEY TO THE SPECIES OF HALOCERATIDAE

A. Larval shell with 2 spiral keels, of which one remains visible above suture ..... *Zygoceras* (p. 726)
A. Larval shell with 3 spiral keels, of which two remain visible above suture ..... (*Haloceras*) B

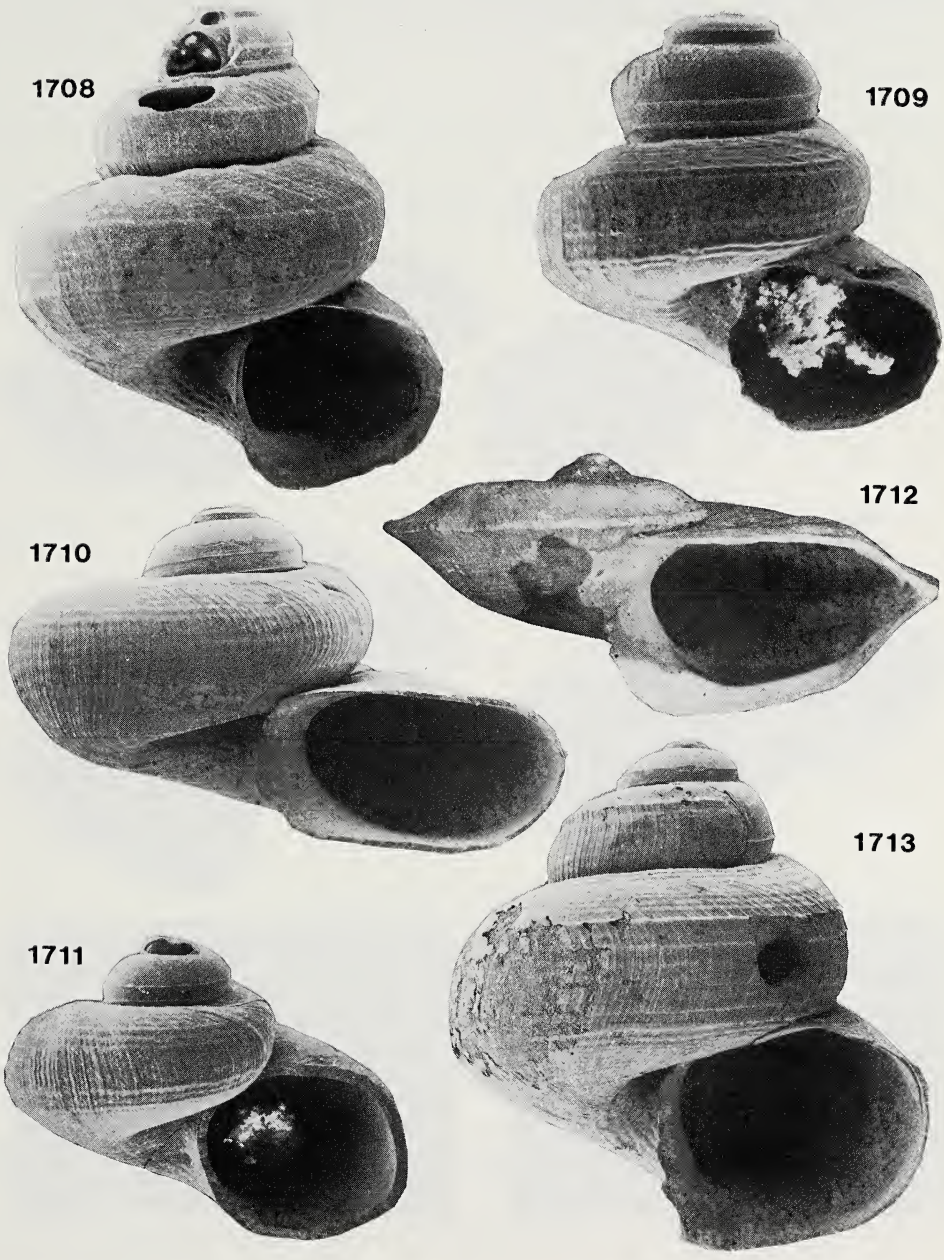
B. Teleoconch whorls with one sharp keel at periphery, protoconch II diameter 1500-2300 μm (mean 1930 μm) consisting of 2.2-2.6 (mean 2.42) whorls ..... *H. tricarinata* (p. 724)
B. Spire depressed (h/D less than 0.7), teleoconch whorls regularly convex or with two keels at periphery C
B. Spire high (h/D more than 0.9), teleoconch whorls convex with two more or less distinct keels at periphery ..... D

C. Teleoconch with convex whorls, no keel; protoconch II diameter 980-1200 μm (mean 1118 μm) consisting of 1.7-1.8 (mean 1.76) whorls ..... *H. laxa* (p. 723)
C. Teleoconch whorls with two spiral keels; protoconch II diameter 1300-1660 μm (mean 1466 μm) consisting of 2.1-2.3 (mean 2.19) whorls ..... *H. cingulata* (p. 723)

D. Teleoconch with broad umbilicus; protoconch II small, diameter 700-920 μm (mean 817 μm) consisting of 1.7-1.9 (mean 1.82) whorls ..... *H. carinata* (p. 722)
D. Teleoconch with narrow umbilicus; protoconch II bigger, diameter 1200-1300 μm (mean 1240 μm) consisting of 2.0-2.1 (mean 2.06) whorls ..... *H. mediocostata* (p. 724)

Genus *HALOCERAS* Dall, 1889

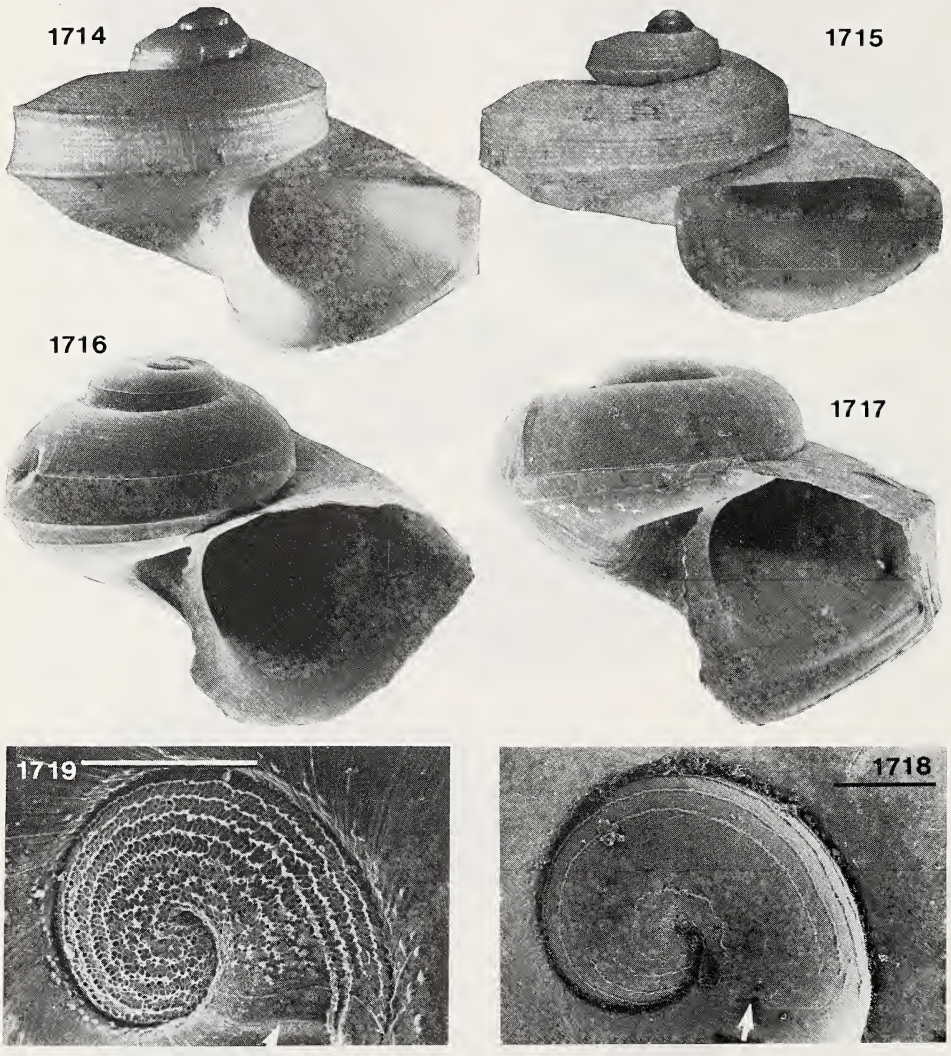
Separatista (Haloceras) Dall, 1889:277. Type species, by monotypy, *Cithna cingulata* Verrill, 1884. Northwestern Atlantic.
Solariella (Micropiliscus) Dall, 1927:130. Type species, by original designation, *S. (M.) constricta* Dall, 1927. Florida.



Figures 1708-1713. Genus *Haloceras*. **1708**, *H. carinata*, BALGIM st CP92, 2.7 mm. **1709**, *H. carinata*, CANCAP st 2.155, 1.6 mm. **1710**, *H. laxa*, SEAMOUNT st CP30, 2.1 mm. **1711**, *H.* cf. *laxa*, THALASSA st Z435, 2.0 mm. **1712**, *H. tricarinata*, GALATHEA st 192, diameter 15.1 mm. **1713**, *H. mediocostata*, lectotype, MONACO Exp st 553, 3.5 mm.

Haloceras carinata (Jeffreys, 1883) Figs 1708-1709, 1719, 1723

Cithna carinata Jeffreys, 1883a:111, pl. 20 fig. 9.
Solariella (Micropiliscus) constricta Dall, 1927:130.
Haloceras carinata: Warén & Bouchet 1991:137, figs 33, 36, 58-61, 105-108.



Figures 1714-1719. Genera *Haloceras* and *Zygoceras*. **1714**, *H. cingulata*, ALBATROSS st 2733, 5.1 mm (USNM 94898). **1715**, *H. cingulata*, BIOGAS st CP37, 8.8 mm. **1716**, *H. tricarinata*, SEAMOUNT st CP30, diameter 2.8 mm. **1717-1718**. *Zygoceras* sp., MONACO Exp st 683, diameter 1.7 mm. **1719**. *H. carinata*, INCAL st DS3. Scale lines 100 μm.
The arrows indicate the protoconch I - protoconch II demarcation.

Type materials: C. carinata, holotype BMNH 1885.11.5.1623; *S. constricta*, 11 syntypes USNM 108414a,b.

Type localities: C. carinata, PORCUPINE Exp 1870 st 16, 39°55' N, 09°56' W, 1809 m, off Portugal; *S. constricta*, ALBATROSS st 2415, 30°44' N, 79°26' W, 805 m, off Florida.

Material examined: The type material and 11 spms and shs in 6 lots (MNHN, RMNH, SMNH).

Distribution: The North Atlantic between 27° N and 42° N, in 700-2075 m (bathyal); amphiatlantic.

Remarks: H. carinata resembles *H. mediocostata* (Fig.1713), which differs by having a larger protoconch, and a broader teleoconch sculptured by stronger spiral keels.

Haloceras cingulata (Verrill, 1884) Figs 1714-1715, 1725

Cithna cingulata Verrill, 1884:184, pl. 32 fig. 7.
Haloceras cingulata: Warén & Bouchet 1991:138, figs 31, 41-42, 53-55, 113-115.

Type material: Holotype USNM 38101.

Type locality: ALBATROSS st 2076, 41°13' N, 66°01' W, 1658 m, Georges Bank, south of Nova Scotia.

Material examined: The type material and 13 spms and shs in 7 lots (USNM, MNHN).

Distribution: The temperate North Atlantic, between 36° N and 49°N, in 1050-2685 m (bathyal); amphiatlantic.

Remarks: There is no species easily confused with *H. cingulata*. The two strong spiral keels appear early on the teleoconch and make identification possible, also of very young specimens.

Haloceras laxa (Jeffreys, 1885) Figs 1710-1711, 1722

Seguenzia laxa Jeffreys, 1885:44, pl. 5 figs 4-4a.
Haloceras laxa: Warén & Bouchet 1991:140, figs 74-75, 116-118.

Type material: Holotype BMNH 1885.11.5.2586.

Type locality: PORCUPINE Exp 1870 st 16, 39°55' N, 09°56' W, 1809 m, off Portugal.

Material examined: The type material and 9 shs in 3 lots (MOM, BMNH, MNHN). Of three additional shells tentatively identified as *Haloceras* aff. *laxa*, one is is shown in Fig. 1711.

Distribution: From the northern part of the Bay of Biscay to the Ibero-Moroccan Gulf and the Azores, in 1000-2200 m.

Remarks: The holotype of *S. laxa* is badly broken and worn, and its identity was discussed by Warén & Bouchet (1991). More shells of haloceratids from the northeastern Atlantic will be needed to match the fragmentary type, and establish its identity with more security. The species for which we are now using the name *H. laxa* (Fig. 1710) can be recognized by the absence of well defined keel at

the periphery of the teleoconch whorls, by its depressed whorls, and small adult size (diameter less than 4 mm). *H. cingulata* (Figs 1714-5) is similarly depressed, but has strongly keeled whorls and a much larger adult size (diameter over 10 mm). *H. carinata* (Figs 1708-9) has a higher spire and considerably smaller protoconch.

The shells referred to as *H.* aff. *laxa* (Fig. 1711) differ in having a stronger spiral sculpture, and more regularly rounded, not depressed whorls. The protoconch sculpture and measurements are however indistinguishable from those in typical *laxa*. Two of these shells originate from the northern part of the Bay of Biscay, while the more depressed specimens are from further south. They may represent variation or belong to a distinct species.

Haloceras mediocostata (Dautzenberg & Fischer, 1896) Figs 1713, 1724

Cithna carinata var. *mediocostata* Dautzenberg & Fischer, 1896:449.
Haloceras mediocostata: Warén & Bouchet 1991:142, figs 56-57, 97-99.

Type material: Lectotype, selected by Warén & Bouchet (1991), in MOM; paralectotype from the same station in MNHN.

Type locality: MONACO Exp st 553, 37°43' N, 25°05' W, 1385 m, Azores.

Material examined: The type material and 3 shs in 2 lots (MOM, IRSN).

Distribution: Only known from the Azores in 1100-1400 m (bathyal).

Remarks: H. mediocostata bears some resemblance to the keeled specimens of *H. carinata* (Figs 1708-9) living in the same part of the North Atlantic, but can be separated by the size of the protoconch (see key). *H. carinata* also has a taller spire.

Haloceras tricarinata (Jeffreys, 1885) Figs 1712, 1716, 1720-1721

Seguenzia tricarinata Jeffreys, 1885:43, pl. 5 fig. 2.
Haloceras tricarinata: Warén & Bouchet 1991:149, figs 37-39, 50-52, 119-120.

Type material: Holotype BMNH 1885.11.5.2589.

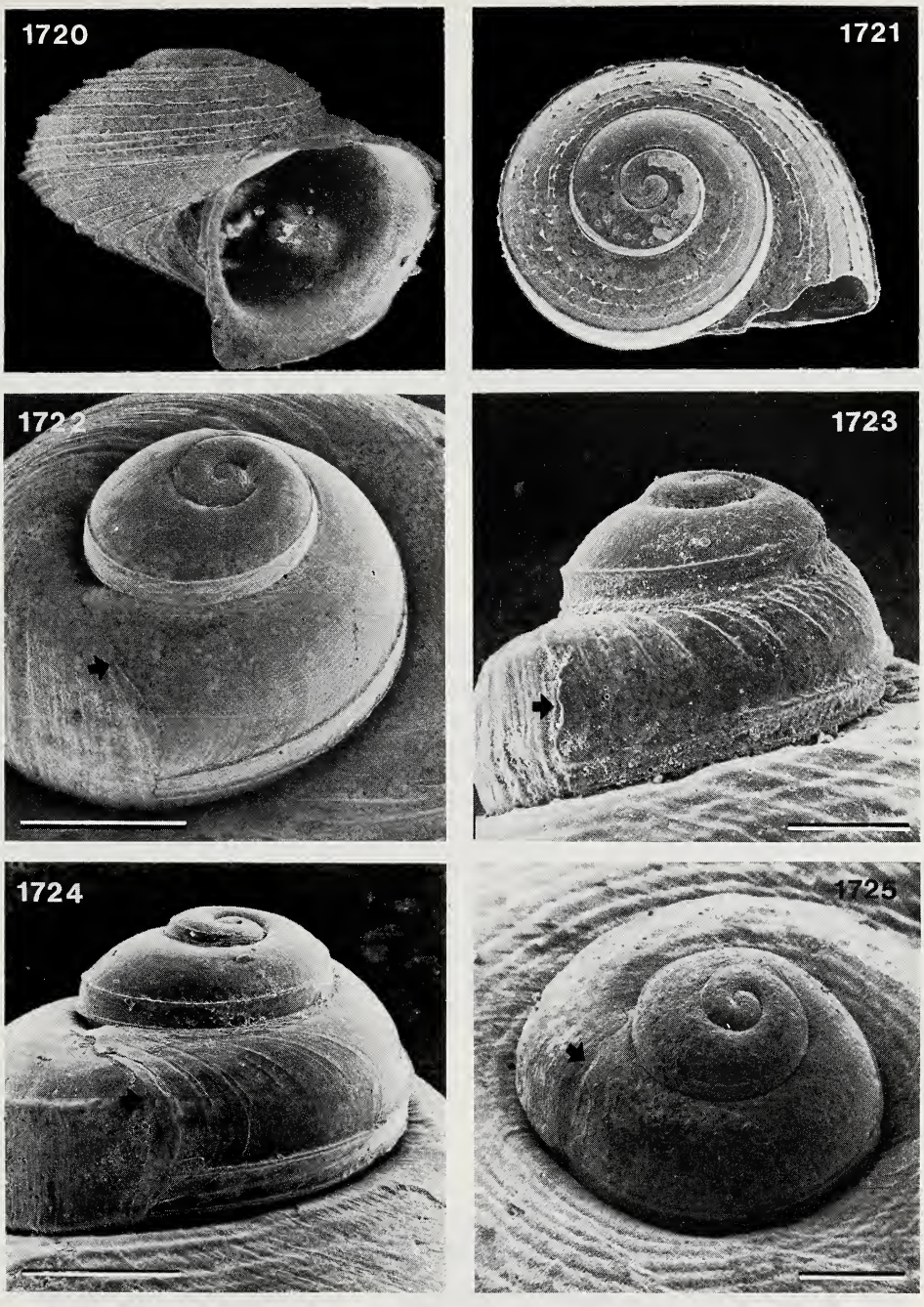
Type locality PORCUPINE Exp 1870 st 17a, 39°39' N, 09°39' W, 1346 m, west of Portugal.

Material examined: The type material and 8 specimens, shells and larvae in 6 lots (MNHN, ZMC, BMNH).

Distribution: Eastern Atlantic Ocean and southwestern Indian Ocean, between 40° N and 32° S, in 1940-3716 m (abyssal).

Remarks: As first noticed by Quinn (1983:744), the holotype of *Seguenzia tricarinata* is a larval shell, and the name rendered by the three strong keels of the larval shell. Of these only the adapical keel remains well visible on the apex of the postlarva. The median keel is usually hidden just above or just below the suture, and the basal (abapical) keel is totally covered by the first teleoconch whorl.

Haloceras tricarinata can be identified, both as a larva and as a benthic snail, by its large protoconch.



Figures 1720-1725. Larvae and protoconchs of *Haloceras*. **1720**, *H. tricarinata*, larva, Bay of Biscay, diameter 2.0 mm. **1721**, *H. tricarinata*, DISCOVERY st 10141, 24°34' N, 19°41' W, 3460-3470m, diameter 1.6 mm. **1722**, *H. laxa*, SEAMOUNT st CP30. **1723**, *H. carinata*, paratype of *Solariella constricta*. **1724**, *H. mediocostata*, MONACO Exp st 553. **1725**, *H. cingulata*, THALASSA st Z453.

Scale lines 500 μm (1722, 1724, 1725), 200 μm (1723).

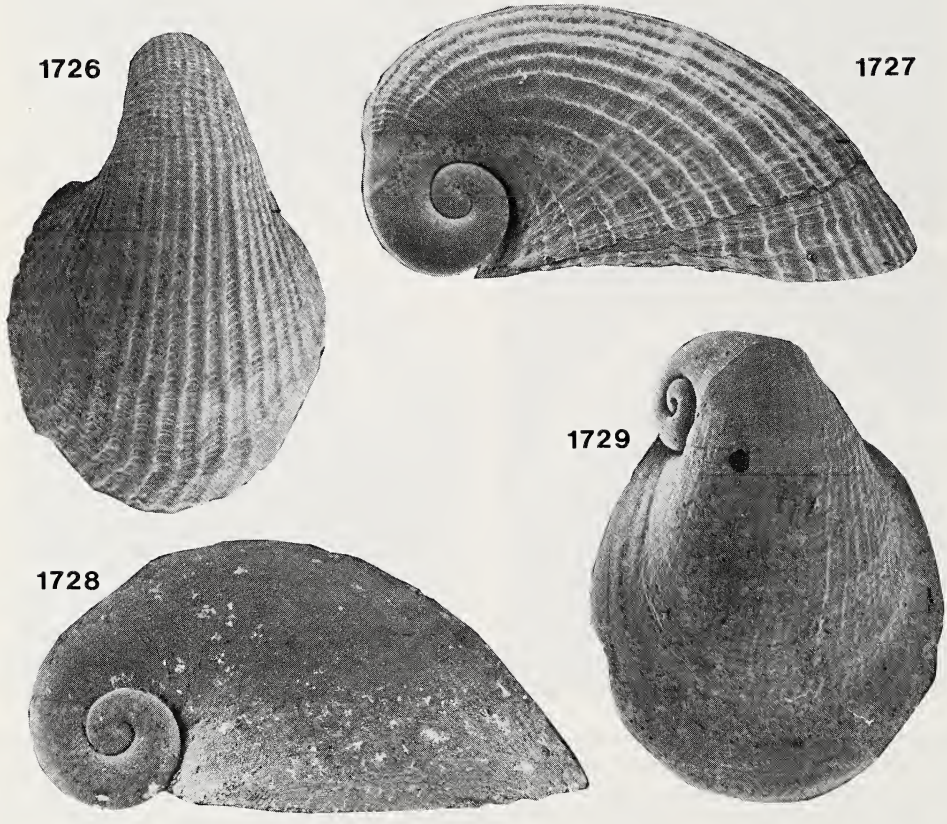
The arrows indicate the protoconch - teleoconch demarcation.

Genus *ZYGOCERAS* Warén & Bouchet, 1991

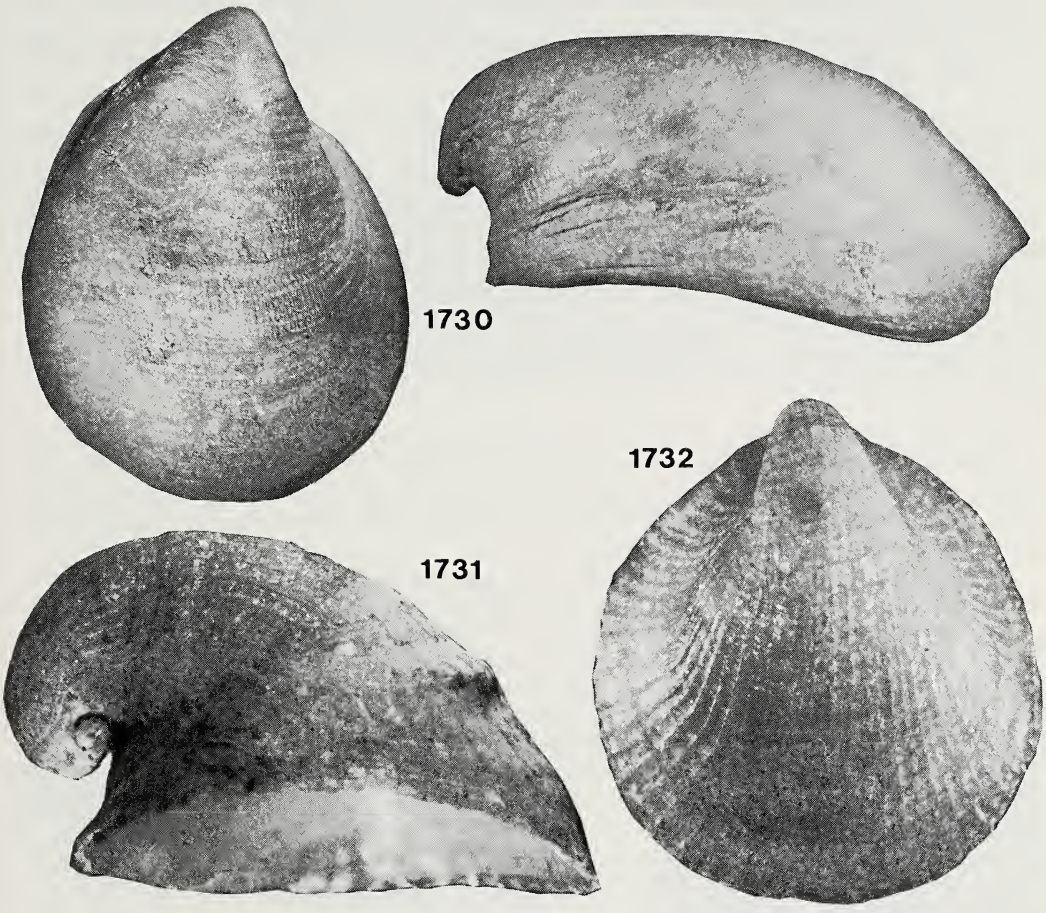
Zygoceras Warén & Bouchet, 1991:152. Type species, by original designation, *Zygoceras tropidophora* Warén & Bouchet, 1991. Southwestern Pacific.

Zygoceras sp. Figs 1717-1718

Remarks: A young shell from MONACO Exp st 683 (38°20' N, 28°05' W, 1550 m, Azores) in MOM, with 0.6 postlarval whorl, represents an undescribed species. Protoconch I, diameter 350 μm, has a sculpture of spiral cords on the nucleus and the abapical, coiled part, leaving a smooth adapical zone. Protoconch II, diameter 980 μm, is low-spired and has 1.25 whorls with only 2 keels instead of 3 as in *Haloceras*. One keel is visible above the suture, a second one concealed by the suture. The teleoconch has two strong keels at the periphery.



Figures 1726-1729. *Capulus*. **1726-1727**, *C. ungaricus*, Koster Area, Sweden, 3.7 and 5.0 mm. **1728-1729**, *C. simplex*, THALASSA st Z447, 3.1 and 3.5 mm.



Figures 1730-1732. *Capulus*. **1730**, *C. simplex*, holotype, 29 mm. **1731-1732**, *C. ungaricus*, Koster area, Sweden, 8.7 and 8.6 mm.

Family CAPULIDAE

Remarks: Reasons have recently been given for considering the Capulidae and the Trichotropidae a single family (Warén & Bouchet 1991), characterised by having an echinospira larva and a pseudoproboscis (actually an elongation of the lower lip).

Most species described in the Capulidae in the classic sense (e.g. Wenz 1940) actually belong to other families, and of the capulids it is only *Capulus* and *Hyalorisia* Dall, 1889, which qualify for inclusion in the family in addition to the trichotropids. Rather few of these species occur in deep water.

Genus *CAPULUS* Montfort, 1810

Capulus Montfort, 1810:54. Type species, by original designation *Patella ungarica* Linné, 1758. Europe.
Brocchia Bronn, 1827:538. Type species, by monotypy, *Patella sinuosa* Brocchi, 1814. Italy,Pliocene. (***Syn. nov.***)

Remarks: The genus includes rather few species, usually living in shallow water, 5-200 m, commensalistic on bivalves, gastropods and brachiopods.

Lebour (1937) and Thorson (1946) described the early larva of *Capulus ungaricus*, based on recently hatched specimens, and showed that it belongs to the echinospira type. The recently hatched specimens have a shell of 0.24 mm diameter. This corresponds well with the first half whorl of *C. ungaricus* (Fig. 1734). This part of the larval shell is not demarcated as in most other gastropod species with planktotrophic development, but the lack of demarcation seems to be a general feature of the larval shell of species with echinospira larvae (*Torellia, Lamellaria, Velutina, Erato* examined). No description of older larvae of *Capulus* exist and we have not succeeded to identify any of the undetermined echinospira larvae which have been described (e.g. Pelseneer 1906), with *C. ungaricus*.

There are, however two types of recently settled *Capulus* larvae in our material, which we also have with enough postlarval growth to allow identification (Figs 1726-1729, 1736-1738). Both have a diameter of about 1.25 mm and a planispiral shell, but the larva of *C. ungaricus* has a smooth periostracum, while a second species, tentatively identified as *C. simplex* has three periostracal keels, more expanded aperture, and a higher shell.

Adult specimens of the two species of *Capulus* can be distinguished by *C. simplex* (Fig. 1728-9) having a more fragile and finely sculptured shell with less prominent spire (cf *ungaricus*, Fig. 1726-7). The larval shell of *Capulus simplex* is distinctly expanded before the transition to the teleoconch, while that of *Capulus ungaricus* increases the diameter of protoconch II evenly, but often has the initial part of the teleoconch expanding more rapidly than later parts.

The generic name *Brocchia* was introduced because of supposed sinistrality. The occurrence of sinistral specimens was denied by Dall (1889:289), who explained this illusion by growth deformation, and pointed out that the larval shell is dextral. Nevertheless, the tale has survived into modern literature (Wenz 1940:898).

Capulus ungaricus (Linné, 1758)
Figs 1726-1727, 1731-1734, 1736, 1741

Patella ungarica Linnaeus, 1758:782.
Patella militaris Linnaeus, 1771:552.
Protomedea ornata O.G. Costa, 1861:74, pl. 11 figs 6a-c.
Capulus hungaricus thorsoni Nordsieck, 1969:255. (*nom. nud.*)

Type materials: P. ungarica, syntypes in the collections of the Linnean Society of London (Hanley 1855:422) and Uppsala University Zoological Museum (Wallin 1991:160), not examined; *P. militaris*, not located, not in London (Hanley 1855), not in Uppsala (Wallin 1991) ; *P. ornata*, unknown.

Type localities: Patella ungarica, "Mare Mediterraneo"; *P. militaris*, unknown; *Protomedea ornata*, not mentioned, presumably Sicily.

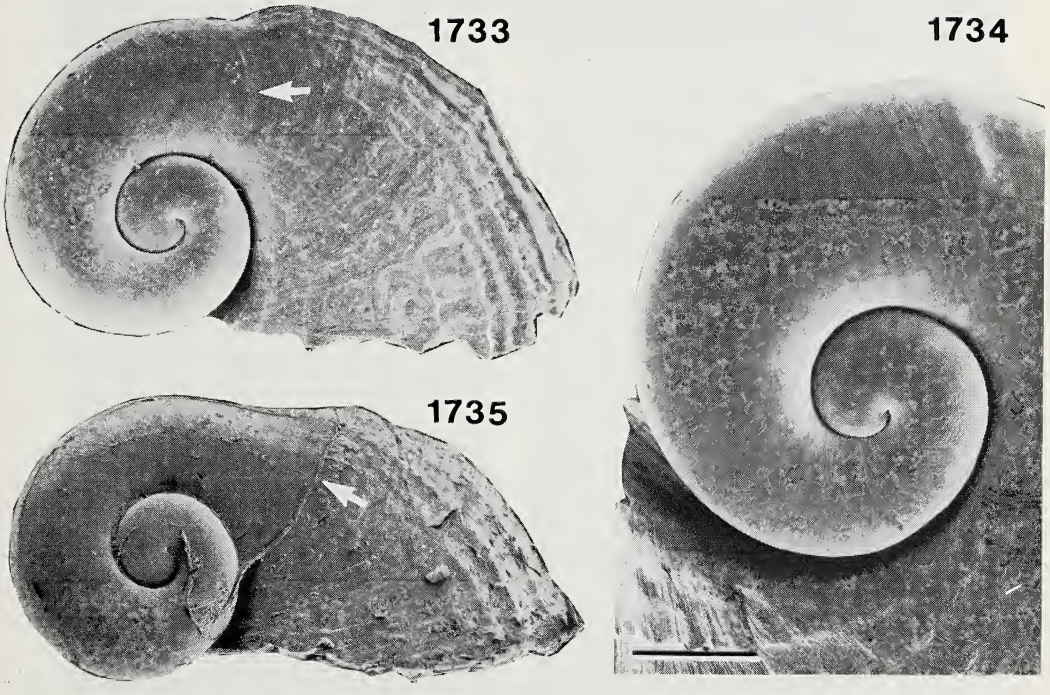
Material examined: About 300 lots with 900 spms, from all parts of the distributional area.

Distribution: From southern Iceland and Hammerfest, northern Norway, west to the Azores and south to the Gulf of Guinea in shallow water and down to about 500 m, rarely deeper, but young specimens were taken alive in the Rockall Trough, 2500 m.

Remarks: Although *C. ungaricus* is listed by American authors from the western Atlantic, examination of numerous specimens from Martha's Vineyard, south to southeastern Florida in USNM did not reveal a single specimen of typical *C. ungaricus*, but all proved to belong to what probably is an undescribed species.

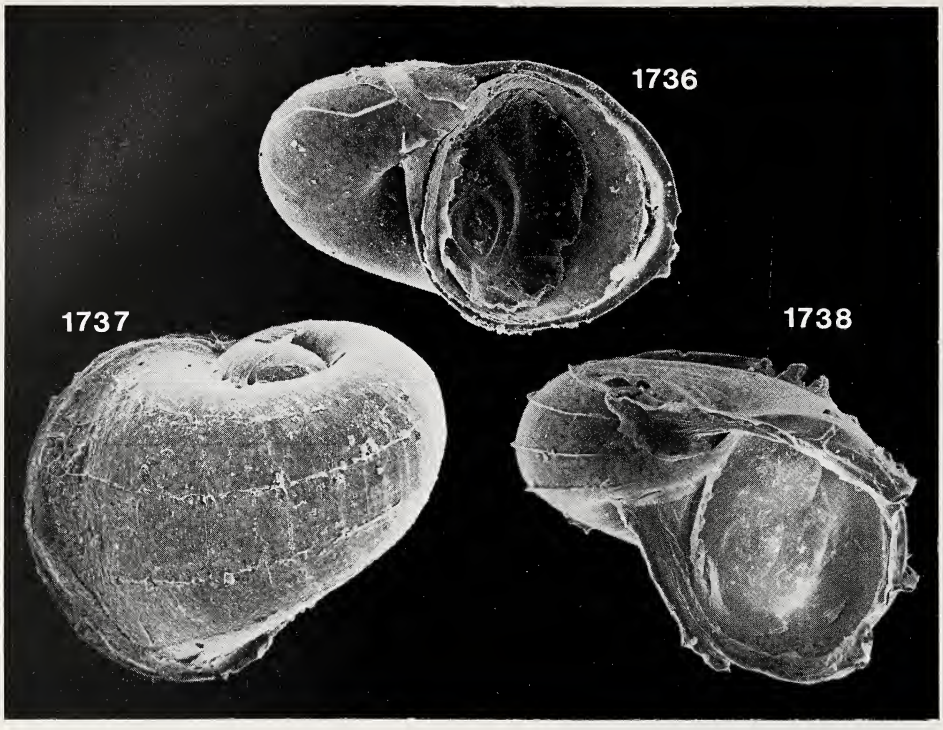
There is no species in the northeastern Atlantic to confuse *C. ungaricus* with, except *C. simplex* (Figs 1728-30, 1735), which lives in deeper water, 300-2000 m. *Capulus simplex* has a broader and lower shell with weaker sculpture, but safe determination of young specimens requires examination of the larval shell, which is higher in *C. simplex* (Figs 1736-1738).

The biology, host choice and reproductive biology of *C. ungaricus* were described by Thorson (1965). *Capulus ungaricus* lives on many anisomyarian bivalves, more rarely on brachiopods (*Macandrewia cranium* and more commonly *Terebratulina retusa* at the Swedish west coast [Warén, unpubl.]), gastropods, and in the Mediterranean also on the tubes of the polychaete *Protula*. The long pseudoproboscis is used to steal food accumulated by the host. The animal is a protandrous hermaphrodite. During the male phase specimens are evidently actively crawling around, presu-



Figures 1733-1735. *Capulus* apex. **1733**, *C. ungaricus*, Calvi, Corsica, 60-80 m, length 1.6 mm. **1734**, *C. ungaricus*, Koster area, Sweden, scale line 200 μm. **1735**, *C. simplex*, INCAL st DS03, 1.75 mm.

The arrows indicate the protoconch - teleoconch demarcation.



Figures 1736-1738. Larval shells of *Capulus*. **1736**, *C. ungaricus*, 46°02' N, 10°19' W, diameter 1.3 mm. **1737-1738**, *C. simplex*, THALASSA st Z447 and INCAL st DS04, both 1.25 mm.

mably inseminating the more sedentary females, although also large males have been found. The larval development is planktotrophic and the veliger larva is of the echinospira type.

Protomedea ornata was synonymized with *C. ungaricus* by Monterosato (1872:58). There seems to be no valid type designation of the generic name *Protomedea* O.G. Costa 1861, but since it has mainly been used for pteropods, we leave the question open.

Capulus simplex Locard, 1898 Figs 1728-1730, 1735, 1738-1739

Capulus simplex Locard, 1898:64, pl. 4 figs 5-8.
Capulus simplex: Dautzenberg 1927:137.

Type material: Holotype in MNHN.

Type locality: TALISMAN 1883 dr 71, 640 m (*fide* Locard, data do not fit with label and station list, see below).

Material examined: The holotype and --BIACORES st 134, 39°18' N, 31°15' W, 850-650 m, 1 sh; PORCUPINE Exp 1870 st 17, 39°42' N, 09°43' W, 1092-1993 m, 7 shs (coll. Sykes, BMNH); INCAL st DS03, 57°25' N, 11°04' W, 609-619 m, 15 young spms; THALASSA st Z447, 48°47' N,

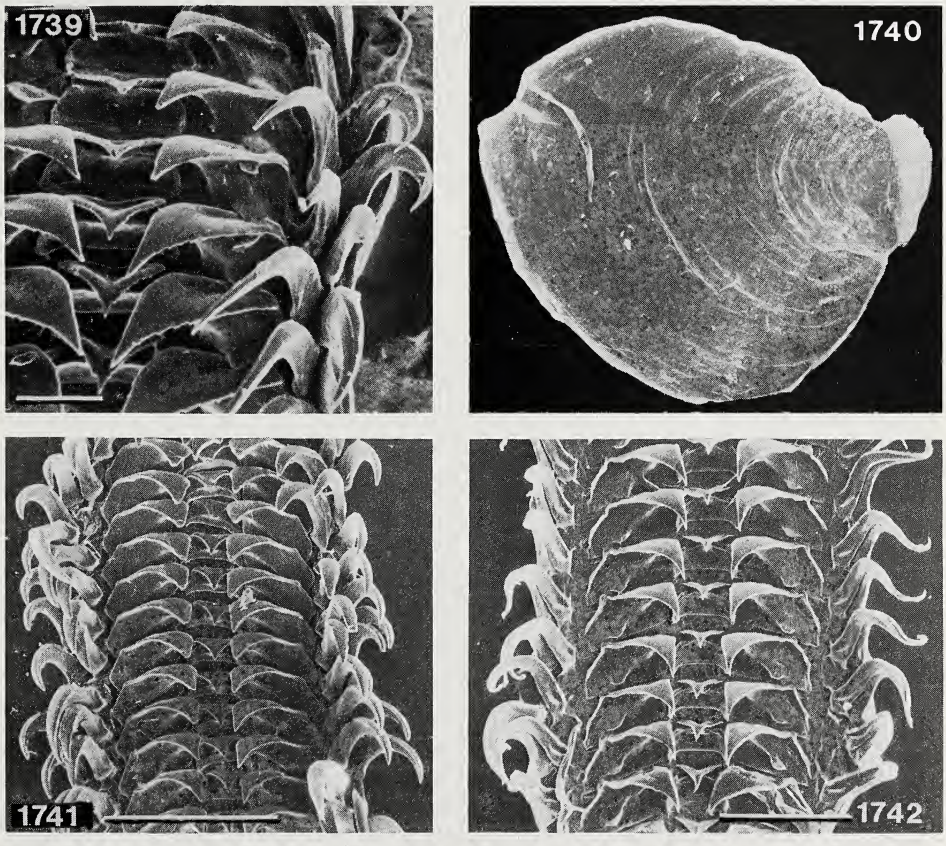
11°13' W, 1430-1550 m, 4 spms; MONACO Exp st 1344, 38°46' N, 28°08' W, 1095 m, 1 spm (IRSN); off southwestern Iceland, Reykjanes Ridge, 300 m, 3 shs (coll. H. Larsen).

Distribution: Only known from the material examined, from southern Iceland to the Bay of Biscay, the Azores, and West Africa, in 300-1992 m.

Remarks: The data of the type locality on Locard's label do not fit the station list, but the station number should probably be 74, which gives a position 25°39' N, 15°58' W, 640 m.

Capulus simplex differs from *C. ungaricus* in having a higher larval shell and a much finer teleoconch sculpture.

Nothing is known about the biology, but the larval shell is of the same type as in *C. ungaricus* and *C. simplex* can be assumed to have an echinospira larva. It can also be assumed that it has a similar feeding biology, but no host records are known.



Figures 1739-1742. Radulae and operculum of Capulidae. **1739-1740**, *Torellia delicata*, Iceland, operculum diameter 3.0 mm. **1741**, *Capulus ungaricus*, Bergen area, Norway. **1742**, *Torellia didyma*. Scale lines 250 μm.

Genus *TORELLIA* Jeffreys, 1867

Torellia Jeffreys, 1867:244. Type species, by monotypy, *T. vestita* Jeffreys, 1867. North Atlantic.
Trachysma Jeffreys, 1874:116. Type species, by monotypy, *Cyclostoma delicatum*, Philippi, 1844. Sicily, Plio-Pleistocene.
Trichoconcha E.A. Smith, 1907:6. Type species, by monotypy, *T. mirabilis* E.A. Smith, 1907. Antarctic.
Neoconcha E.A. Smith, 1907:6. Type species, by monotypy, *N. vestita* E.A. Smith, 1907 [= *Torellia smithi* Warén, Arnaud & Cantera, 1986]. Antarctic.
Torellia (Schismospira) Numanami & Okutani, 1990:81. Type species, by original designation, *Trichotropis planispira* E.A. Smith, 1907. Antarctic.

Remarks: Warén *et al.* (1986) and Warén (1991) have discussed most of the synonymy above. After those papers were finished, Numanami & Okutani (1990) described *Schismospira*, basing the decision on supposed radular differences. We are not convinced that the supposed radular differences were not the result of the SEM stub being tilted backwards and forwards respectively (cf. Numanami & Okutani 1990:figs 3A-C).

All capulids seem to be filter-feeders, judging from their soft parts which are quite similar to those of *Capulus*. It is not known to what extent members of genera other than *Capulus* steal food from other filter feeders, like *Capulus ungaricus* does.

Torellia delicata (Philippi, 1844)

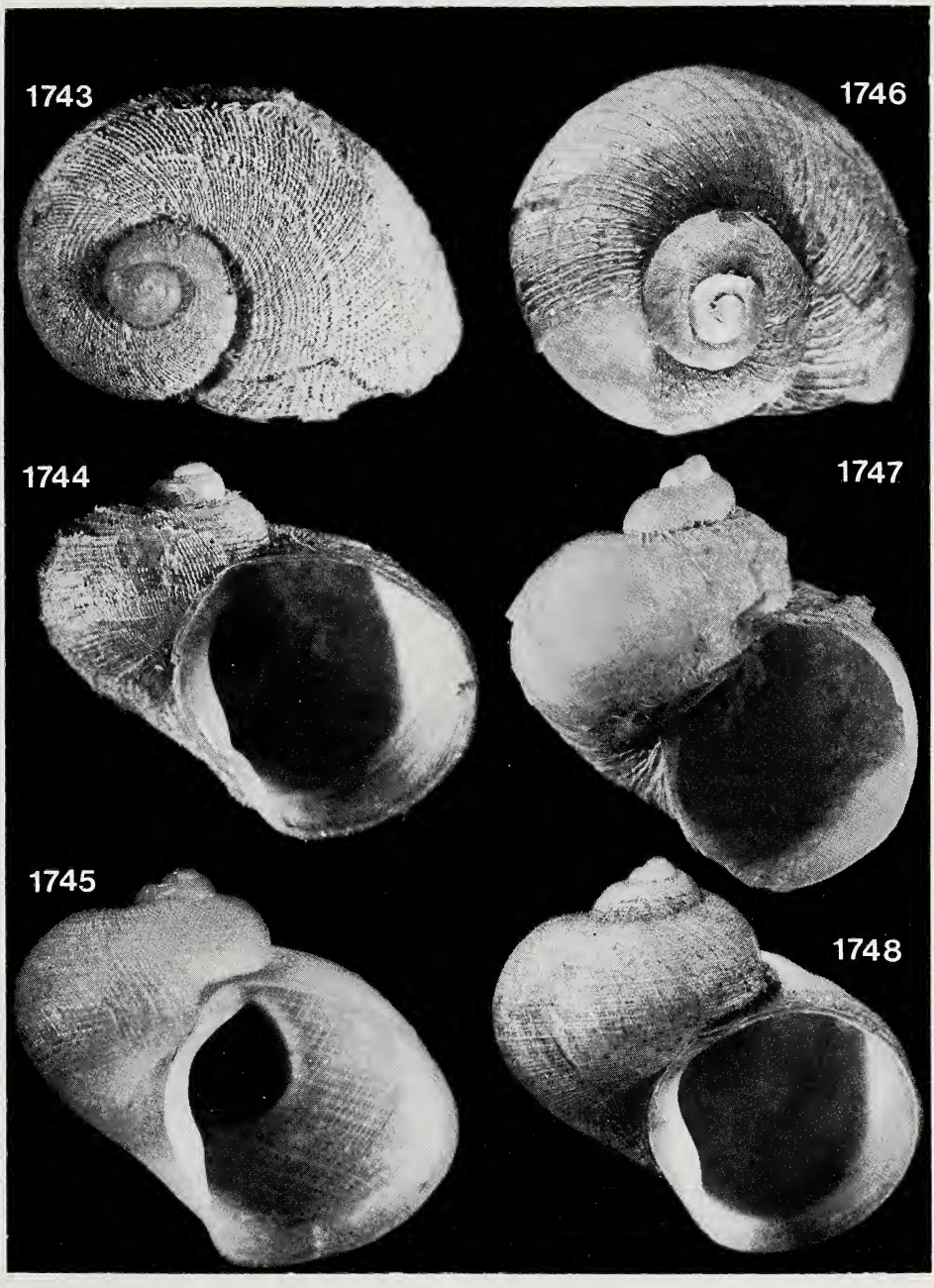
Figs 1739-1740, 1743-1745, 1748, 1750-1754

Cyclostoma delicatum Philippi, 1844a:222, pl. 28 fig. 3.
Torellia vestita Jeffreys, 1867:244, pl. 4 fig. 1.
Janthina delicata: Seguenza 1867:19.
Trachysma fragilis and var. *expansa:* G.O. Sars, 1878:212, pl. 22 figs 17, 18.
Torellia fimbriata and var. *tiarella* Verrill & Smith, *in* Verrill, 1882:520, pl. 57 figs 27-27a.
Torellia vestita var. *abyssicola* Friele, 1903:7.

Type materials: C. delicatum, lost, not in ZMHU; *T. vestita*, holotype USNM 188943; *T. fimbriata*, holotype USNM 45415; *T. fimbriata* var. *tiarella*, lectotype selected by Johnson (1989:70, pl. 10 fig. 3), USNM 45431; *T. vestita* var. *abyssicola*, ZMB.

Type localities: C. delicatum, Plio-Pleistocene, Sicily; *T. vestita*, eastern coast of Shetland; *T. fimbriata* and var. *tiarella*, off Martha's Vineyard, 258-470 m; *T. vestita* var. *abyssicola*, north of the Faroes, 2100 m.

Material examined: The types mentioned above and:
--East Atlantic. --BIOGAS st CP01, 47°35' N, 08°39' W, 2315 m, 2 spms; st CP06, 44°10' N, 04°16' W, 2170 m, 1 sh; st CP07, 44°10' N, 09°31' W, 2170 m, 2 spms; st CP08, 47°33' N, 08°39' W, 2177 m, 1 spm; st CP20, 44°23' N, 04°51' W, 4459 m, 2 shs; st CP37, 47°34' N, 08°39' W, 2175 m, 18 spms; st DS51, 44°11' N, 04°15' W, 2430 m, 1 spm; st DS61, 47°35' N, 08°39' W, 2250 m, 2 young;st DS65, 47°36' N, 08°41' W, 2360 m, 6 young; st DS71, 47°34' N, 08°34' W, 2194 m, 1 larva; st DS87, 44°05' N, 04°16' W, 1894 m, 1 larva; INCAL st CP05, 55°00' N, 12°30' W, 2884 m, 1 larva; st CP09, 50°15' N, 13°16' W, 2659-2691 m, 1 larva; st CP10, 48°26' N, 15°15' W, 4823 m, 2 young; st DS01, 57°59' N, 10°40' W, 2091 m, 19 larvae and young; st DS02, 57°59' N, 10°49' W, 2081 m, 10 larvae; st DS03, 57°25' N, 11°04' W, 609-619 m, 2 larvae; st DS09, 55°08' N, 12°53' W, 2081-2091 m, 2 spms; st WS04, 48°19' N, 15°14' W, 4829 m, 1 spm; INGOLF Exp st 78, 61°28' N, 26°25' W, 780 m, 5 shs (ZMC);



Figures 1743-1748. Genus *Torellia*. **1743-1744**, *T. delicata*, BIOGAS st CP20, diameter 9.9 mm. **1745**, *T. delicata*, Ibero-Moroccan Gulf, 8.3 mm. **1746-1747**, *T. didyma*, BIOGAS st CP09, diameter 7.5 mm. **1748**, *T. delicata*, Björns Rev, Koster Area, Sweden, 90 m, 12.9 mm.

POLYGAS st DS15, 47°35' N, 08°40' W, 2246 m, 2 spms; PORCUPINE Exp 1870 st 17, 39°42' N, 09°43' W, 1092-1993 m, 5 shs (coll. Sykes, BMNH); --BALGIM st 98, 34°29' N, 07°42' W, 1721-1773 m, 1 sh; SEAMOUNT st CP30, 36°44' N, 11°23' W, 1940-2075 m, 20 shs and fragments, fossil?; st DW106, 42°42' N, 11°49' W, 765 m, 1 sh (SMNH); st DW116, 42°52' N, 11°51' W, 985-1000 m, 6 shs (SMNH); THALASSA st Z417, 48°12' N, 09°10' W, 865 m, 1 spm; east of Koster Islands, Swedish western coast, 150 m, 1 spm (SMNH); eastern Iceland, Hornafirdirmid, 6 spms (Akureyri and Husavik Museums); eastern Iceland, Stokknesgrunn, 1 spm (Akureyri Museum); western Iceland, Jökultunga, from haddock stomachs, 2 spms (coll. H. Larsen); -Norway, Lofoten, 364-546 m (USNM 188944, ex G.O.Sars); Norway, Near Florö, Bergen, 473 m (USNM 18956, ex Friele); western Norway, off Korsfjord, 250-325 m, 6 samples, 8 spms (SMNH); western Norway, lesund, 91 m (USNM 188945, ex G.O. Sars); northern Norway, NORBI st CP11, off Tromsö 350 m, 5 spms.

--Western Atlantic. USFC st 1033, 39°56' N, 69°24' W, 333 m, 6 spms (USNM 49997, 45419); USFC st 1038, 39°58' N, 70°06' W, 266 m, 29 spms (USNM 226040, 45432); USFC st 1092, 39°58' N, 69°42' W, 367 m, 2 spms (USNM 45433); USFC st 1095, 39°55' N, 69°47' W, 584 m, 2 spms (USNM 45422); USFC st 1097, 39°54' N, 69°44' W, 288 m, 1 spm (USNM 45423); USFC st 1098, 39°53' N, 69°43' W, 284 m, 2 spms (USNM 45436); USFC st 1138, 39°39' N, 71°54' W, 306 m, 2 spms (USNM 45424); USFC st 1139, 39°37' N, 71°55' W, 530 m, 1 spm (USNM 45425); USFC st 1153, 39°54' N, 70°37' W, 410 m, 1 spm (USNM 45437); USFC st 1154, 39°55.5' N, 70°39' W, 350 m, 4 spms (USNM 45438, 45427); USFC st 2089, 39°59' N, 70°40' W, 306 m, 2 spms (USNM 34738); USFC st 2092, 39°58.5' N, 71°00.5' W, 360 m, 1 spm (USNM 34755); USFC st 2262, 39°55' N, 69°30' W, 455 m, 1 spm (USNM 40348); USFC st 2429, 42°56' N, 50°51' W, 857 m, 1 spm (USNM 50383); USFC st 2536, 39°56' N, 70°48' W, 286 m, 1 spm (USNM 50964); USFC st 2582, 39°30' N, 71°43' W, 249 m, 4 spms (USNM 53090); USFC st 2583, 39°51' N, 71°43' W, 238 m, 2 spms (USNM 103450); USFC st 2589, 38°55' N, 72°51' W, 420 m, 5 spms (USNM 53205); USFC st 871, 40°03' N, 70°24' W, 257 m, 1 spm (USNM 45428); USFC st 872, 40°06' N, 70°24' W, 156 m, 1 spm (USNM 45429); USFC st 939, 39°53' N, 69°51' W, 480 m, 2 spms (USNM 45416).

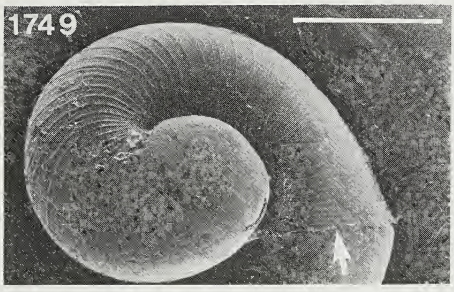
Mediterranean: --36°17' N, 13°42' E, 870-611 m, 5 shs, glacial fossils (Bouchet & Taviani 1989).

Distribution: Both sides of the Atlantic, eastern and western Iceland, northern Norway, south to the Ibero-Moroccan Gulf and the Gorringe Bank; also the central Mediterranean (only shells south of the Bay of Biscay). Depth range 100-2500 m.

Remarks: Warén (1991) reviewed the nomenclatorial history, synonymized *Torellia vestita* with the older name *Cyclostoma delicata*. This decision was based on Philippi's and Seguenza's good figures and Jeffreys' holotype.

Figures 1749-1754. Larval shells of *Torellia*. **1749**, *T. didyma*, holotype, scale line 0.5mm. **1750-1754**, *T. delicata*. **1750**, larval shell with postlarval growth, without periostracum, THALASSA st Z417, diameter 2.0 mm. **1751**, newly metamorphosed larva, Bay of Biscay, 1.4 mm. **1752**, newly metamorphosed larva without periostracum, BIOGAS st DS51, 1.7 mm. **1753**, initial whorl of larva in fig. 1750, scale line 100 μm. **1754**, larval shell with postlarval growth, with periostracum, Bay of Biscay, diameter of larval shell 1.5 mm.

The black arrow indicates the protoconch I - protoconch II demarcation. The white arrows indicate the protoconch - teleoconch demarcation.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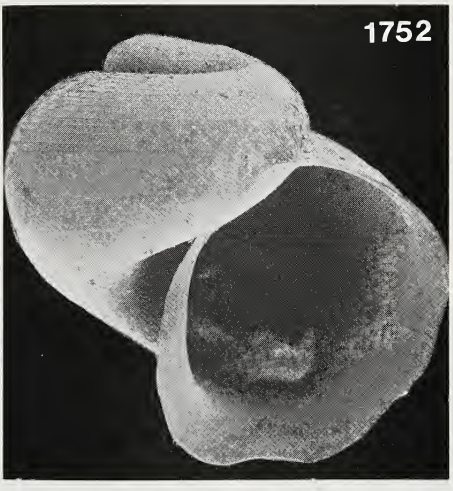
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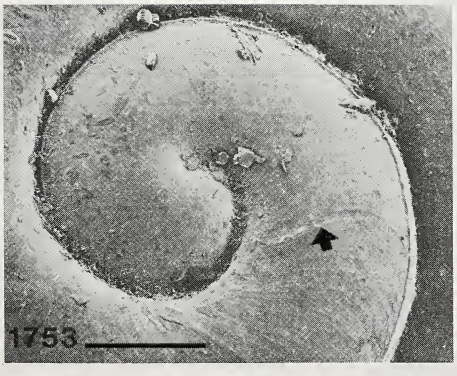
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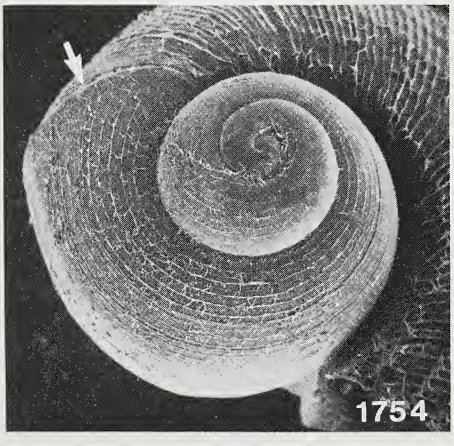

1754

Torellia didyma sp.n. Figs 1742, 1746-1747, 1749

Type material: Holotype in MNHN.

Type locality: INCAL st WS04, 48°19' N, 15°14' W, 4829 m, Bay of Biscay.

Material examined: The types and --ABYPLAINE st DS13, 44°41' N, 17°53' W, 4990 m, 1 spm; BIOGAS st CP09, 47°33' N, 08°44' W, 2179 m, 1 spm.

Distribution: Only known from the material examined, from the Bay of Biscay and west of Spain, in 2100-5000 m.

Description: Shell (Figs 1746-7) very similar to *Torellia delicata* (Figs 1743-5, 8), but with paucispiral protoconch. Larval shell (Fig. 1749) consisting of 3/4 of a whorl, convex with deep suture, clearly demarcated from teleoconch and sculptured by about 40 distinct axial ribs, reaching from suture to suture and becoming more obsolete towards initial part, where they fade away. Diameter 1.26 mm. Holotype with 2.1 postlarval whorls, slightly more slowly increasing their diameter than in *T. delicata*. Spire somewhat higher than in *T. delicata*. Umbilicus absent or consisting of a narrow crevice.
Height of holotype 7.5 mm.
Operculum identical to that of *T. delicata* (Fig. 1740)
Radula (Fig. 1742), poorly hardened in the investigated specimen, similar to *T. delicata*.
Etymology: Didymos (Greek) meaning twin, referring to the similarity to *T. delicata*.

Remarks: This new species differs from *T. delicata* in having a paucispiral larval shell, lacking an umbilicus and having a higher spire.

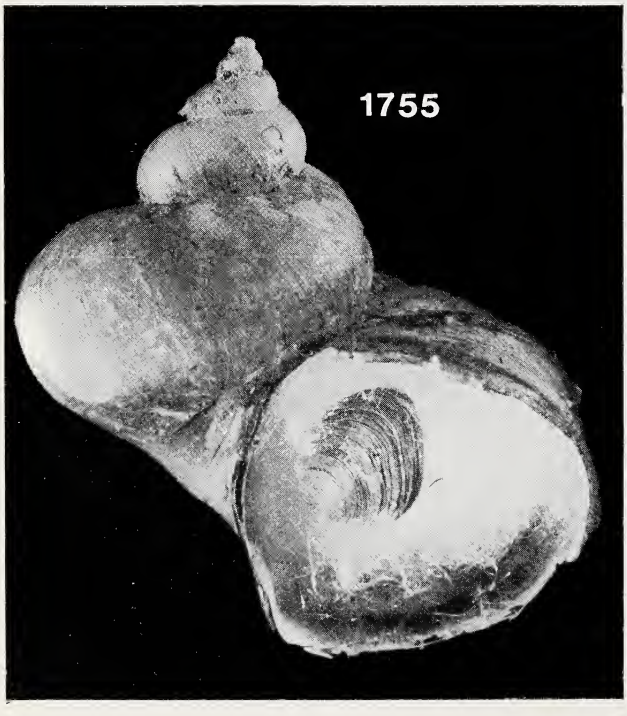


Figure 1755.
Trichotropis bicarinata tenuis, Kolbeinsöy, northern Iceland, 28 mm.

Genus *TRICHOTROPIS* Broderip & Sowerby, 1829

Trichotropis Broderip & Sowerby, 1829:373. Type species, by monotypy, *Turbo bicarinatus* Sowerby, 1825. Arctic.

Remarks: Trichotropis is a genus mainly occurring in shallow water in cold temperate areas.

Trichotropis bicarinata tenuis E.A. Smith, 1877 Fig. 1755

(*Turbo bicarinatus* Sowerby, 1825:XII.)
Trichotropis tenuis E.A. Smith, 1877:136, textfig.
Trichotropis hjorti Friele, 1903:8, pl. 1 figs 4-5, pl. 3 figs 1-2.
Trichotropis bicarinata tenuis: Warén 1991:82, figs 21A-D.

Type materials: T. tenuis, holotype BMNH 1877.8.3.1; *T. hjorti*, 2 syntypes ZMB 5387.

Type localities: T. tenuis, off Cape Louis Napoleon, Grinnell Land, northern Greenland, 79°38' N, 40 m; *T. hjorti*, east of Iceland, 600 m.

Material examined: Listed by Warén (1991:82).

Distribution: From western and eastern Greenland, northern Iceland and eastwards, to the north of Spitsbergen, in 80-600 m. The nominal species occurs off western Greenland, north of Canada and Alaska, south to Japan in the Pacific, and off eastern and northeastern Siberia in 10-200 m.

Remarks: Trichotropis bicarinata tenuis was discussed in some detail by Warén (1991), who concluded that this arctic Atlantic deep-water form is a subspecies of the more shallow north Pacific *T. bicarinata*.

Family VELUTINIDAE

The family comprises mainly the genus *Velutina*, but also a few species previously classified in the Trichotropidae belong here (see Warén 1989a). The biology is known only for the genus *Velutina*, which are predators on Ascidians, but a predatory diet can be assumed also for other species of the family since their radulae are similar to that of *Velutina*.

Genus *PSEUDOTORELLIA* Warén, 1989

Pseudotorellia Warén, 1989a:16. Type species, by original designation, *P. fragilis* Warén, 1989.

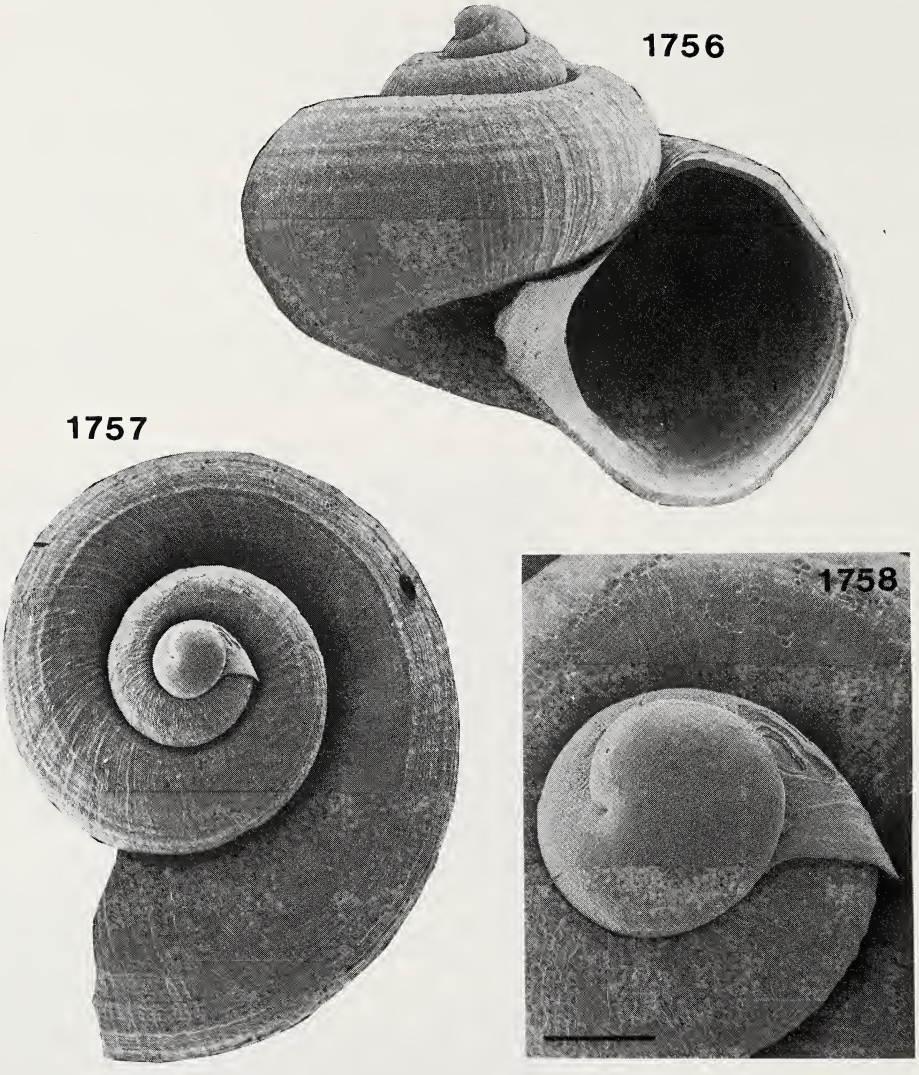
Remarks: We have seen one additional, undescribed species from deep water in the Philippines.

Pseudotorellia fragilis Warén, 1989 Figs 1756-1759

Pseudotorellia fragilis Warén, 1989a:17, figs 11, 12B.

Type material: Holotype SMNH 3905.

Type locality: Reykjanes Ridge, off southwestern Iceland, 150-400 m.



Figures 1756-1758. *Pseudotorellia fragilis*, paratype, Iceland, 64°55' N, 25°05' W, 157 m. **1756-1757**, diameter 4.1 mm. **1758**, larval shell, scale line 250 μm.

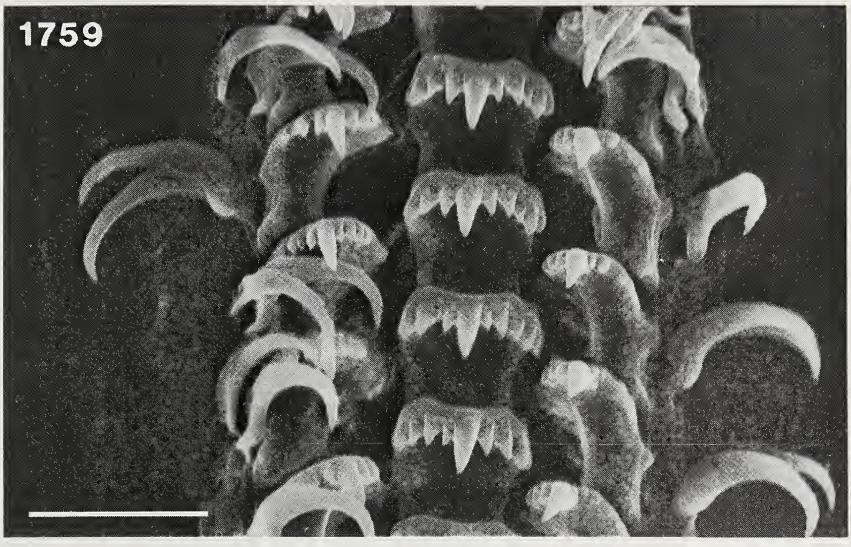


Figure 1759. *Pseudotorellia fragilis*, radula, scale line 200 μm.

Material examined: Listed by Warén (1991:85).

Distribution: Only known from the material examined, off southern Iceland in 150-400 m.

Remarks: Pseudotorellia resembles species of *Torellia* (Figs 1743-8), but can be recognized by having a more planispiral shell, rounder aperture and a broad, deep umbilicus. Also the radulae are widely different and typical for the families Velutinidae (Fig. 1759) and Capulidae (Figs 1739, 1741-2) respectively.

Nothing is known about the biology of *Pseudotorellia* except that the larval shell clearly indicates a non-planktotrophic development.

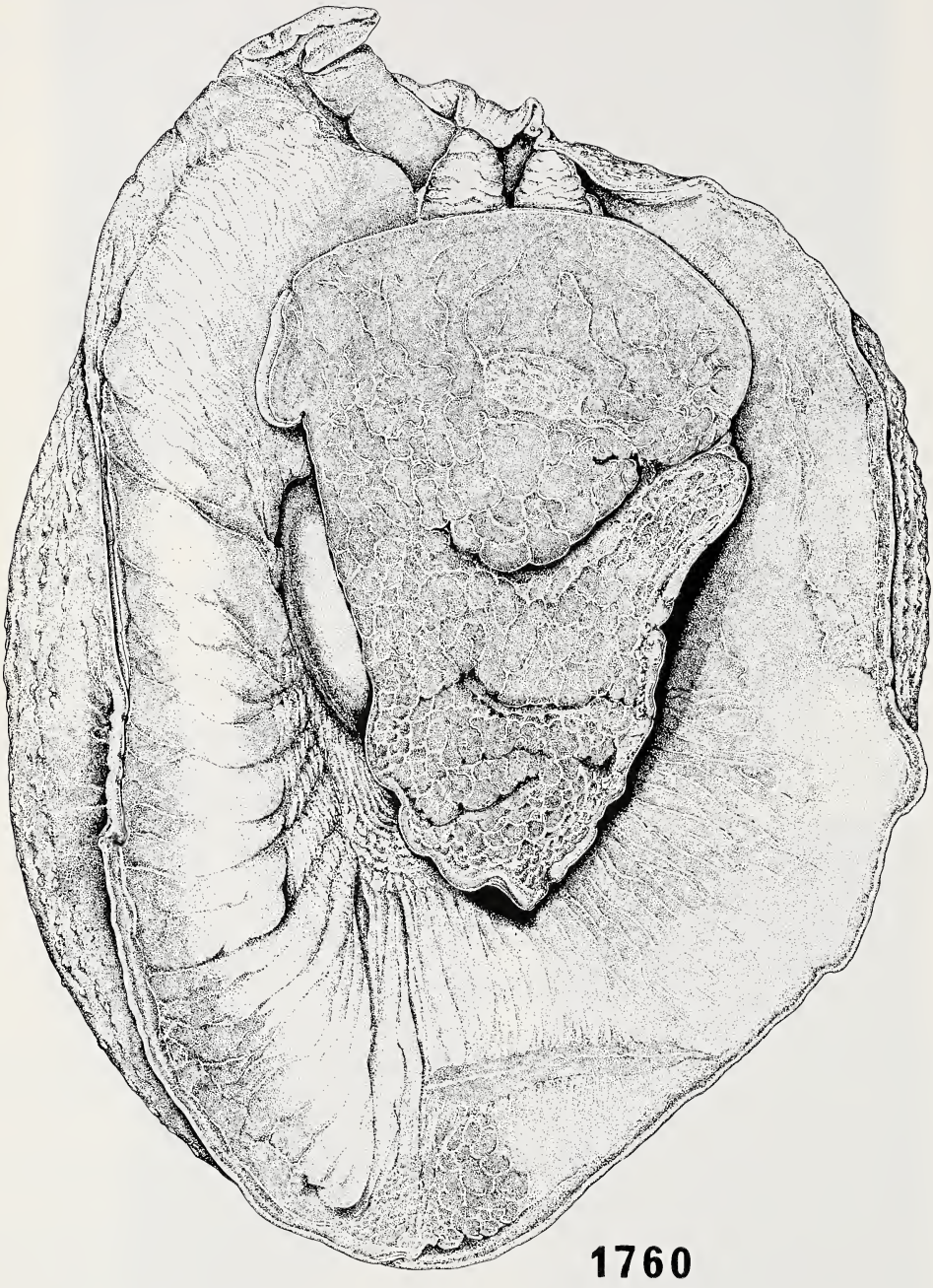
Family LAMELLARIIDAE

The taxonomy of the family Lamellariidae is not well known and few authors except Bergh (1853, 1886, 1887) have made any major contribution. It seems as if prosobranch specialists consider these almost shell-less animals not to belong to their groups, and most contributions have come from opisthobranch specialists.

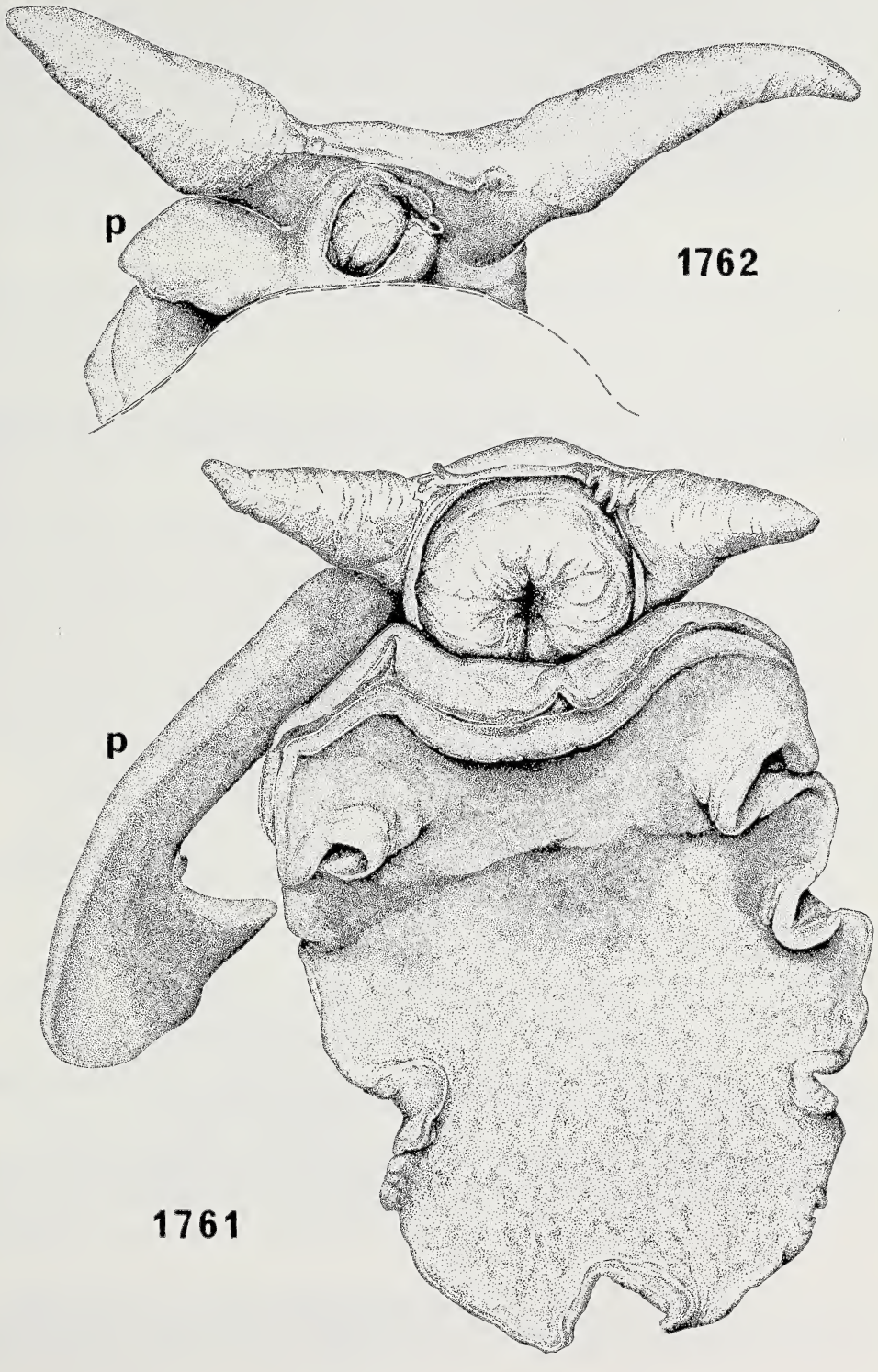
Two genera which have their main distribution on the continental shelf of Arctic regions occasionally have been reported from deep water.

Species of *Onchidiopsis* Bergh, 1853 are high-arctic and arctic and live at depths between 5 and 200 m as far south as Iceland, with one record in 600 m (Friele 1903). The taxonomy and anatomy of the three recognized North Atlantic species has been revised by Odhner (1913); we also should like to draw attention to Jensen's nomenclatural notes published by Thorson (1944:64).

Marsenina glabra (Couthouy, 1839) also occurs on the continental shelf of the arctic regions, from Spitzbergen to western Norway and eastern Iceland, with occasional records down to 1200 m (Friele & Grieg 1901:67 as *M. micromphala*; Friele 1903); we refer to Odhner (1913) for a treatment of *Marsenina*.



Figures 1760-1762. *Calyptoconcha pellucida*. **1760**, ventral view of female specimen, Iceland, 63°01' N, 22°10' W, 550-577 m. **1761**, NORATLANTE st B4, cephalic region of specimen with developing penis. **1762**, NORATLANTE st B4, ventral view of male specimen with large penis (p); the mantle has not been drawn.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1762
p
1761

The taxonomy of the shallow water representatives of the family is poorly understood, also in Europe. Planktonologists usually distinguish two species of *"Lamellaria"* larvae in the plancton of the British Channel (Lebour 1935) and of the Mediterranean (Thiriot-Quiévreux 1969, Richter & Thorson 1975), but the corresponding adults are not adequately known. British and Mediterranean authors traditionally list *L. perspicua* (Linné, 1758) and *L. latens* (Müller, 1776) in regional checklists, but the distinction of these forms is problematic and need further attention.

At five occasions deep-water lamellarids have been reported from off western Europe, but the family is very poorly represented in the world-wide deep-sea collections we have examined.

Genus *CALYPTOCONCHA* gen. n.

Type species: Lamellaria pellucida Verrill, 1880.

Diagnosis: Lamellarids with large and fleshy mantle completely covering the shell; only anterior exhalant fold present; radula 1.C.1, central tooth with broad square basal plate; penis inserted just to the right of the right cephalic tentacle.

Remarks: The radula of *Calyptoconcha* is similar to that of *Lamellaria* Montagu, 1815 (and of the genera treated as synonyms or sections of *Lamellaria* by Thiele 1929:266) in having a single lateral tooth and no marginals, but in *Lamellaria* the base of the central tooth forms a strongly arched inverted V (Fig. 1771). Such a central tooth is also present in *Marseniella borealis* Bergh, 1886 (type of the genus *Marseniella*), which differs from *Lamellaria perspicua* (Figs 1763, 1771) only by the shell being incompletely calcified, a character we consider not to be of generic importance. Other lamellarid genera have a radula with the formula 2.1.C.1.2, with 2 marginals and a central tooth with broad basal plate (Bergh 1887, Odhner 1913, Vayssière 1906). We find it more probable that *Calyptoconcha* was derived from one of these genera (which inhabit polar waters) by loss of the marginal teeth, rather than from the *Lamellaria* stock (from shallow warm waters) by modification of the central tooth.

Calyptoconcha pellucida (Verrill, 1880) Figs 1760-1762, 1764-1770

Lamellaria pellucida Verrill, 1880a:395; 1882:518, pl. 58 figs 4, 5-5a.
Lamellaria pellucida var. *gouldii* Verrill, 1882:518, pl. 58 fig. 3.
Oncidiopsis aurantiaca (P. Fischer ms.) Locard, 1897:485, pl. 22 figs 16-17.
Marsenia leptolemma Bergh, 1899:31, pl. 1 figs 1-14, pl. 2 figs 1-5.
Lamellaria pellucida var. *farrani* Odhner, 1926:31, textfigs 19-24, pl. 1 figs 6-7.

Type materials: L. pellucida, holotype USNM 202846; *L. pellucida* var. *gouldii*, holotype USNM 203248; *O. aurantiaca*, holotype in MNHN; *M. leptolemma*, holotype in MOM.

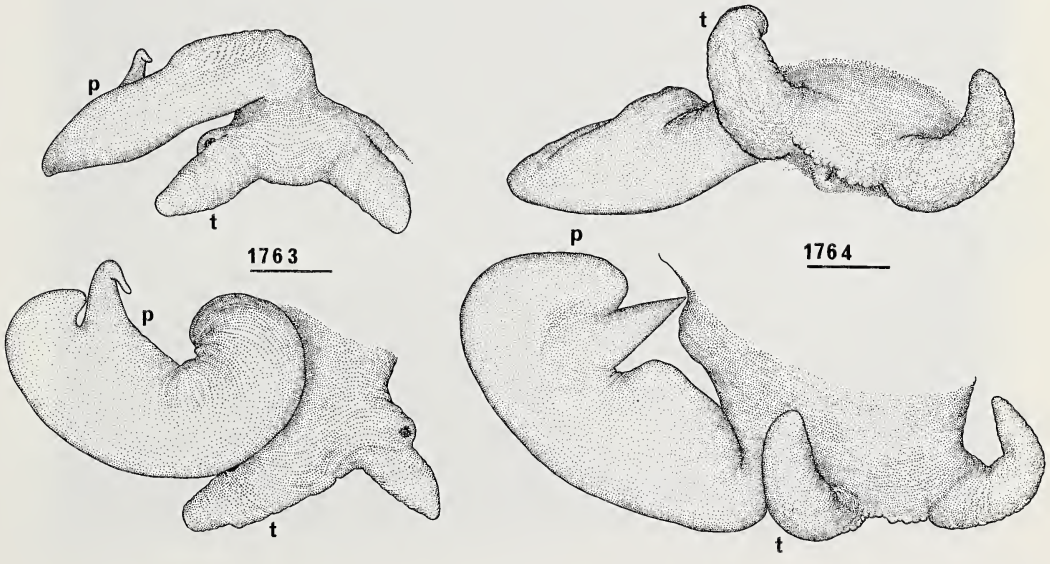
Type localities: L. pellucida, FISH HAWK st 871, 40°03' N, 70°24' W, 210 m, off Delaware Bay, northeastern United States; *L. pellucida* var. *gouldii*, FISH HAWK st 946, 39°55' N, 71°14' W, 452 m, off New England; *O. aurantiaca*, TRAVAILLEUR 1880 dr 17, 43°33' N, 02°10' W, 306 m, Bay of Biscay; *M. leptolemma*, MONACO Exp st 730, 39°03' N, 27°55' W, 730 m, Azores; *L. pellucida* var. *farrani*, Röberg, Trondheim Fjord, Norway.

Material examined: The type material and --ALBATROSS st 2004, 37°20' N, 74°26' W, 187 m, 1 dried spm (USNM 35312); st 2571, 40°09' N, 67°09' W, 2482 m, 10 dried spms (USNM 52076, 52895); st 2746, 38°46' N, 73°06' W, 187 m, 1 dried spm (USNM 76862); TALISMAN, labelled "dr

135, 13 juillet, 250 m", apparently error for dr 91, 21°51' N, 17°28' W, 235 m (13 July), 1 spm (dr 135 was carried out 25 August, 43°15' N, 19°20' W, 4165 m); BIACORES st 136, 39°31' N, 31°05' W, 500-800 m, 1 spm (dry); st 180, 37°57' N, 25°33' W, 1069-1235 m, 1 spm; st 202, 37°26' N, 25°00' W, 2900 m, 3 spms; st 237, 37°21' N, 25°45' W, 645-760 m, 2 spms; st 252, 47°35' N, 08°47' W, 2550-2700 m, 1 spm; st 259, 48°07' N, 07°51' W, 190 m, 4 spms; J CHARCOT Muséum st 12, 48°01' N, 07°03' W, 130 m, 1 spm; st 27, 47°28' N, 06°27' W, 170-210 m, 1 spm; Cap Breton Canyon, 43°53' N, 02°08' W, 206 m, 1 spm (MNHN, Sorbe & Gofas leg.); NORATLANTE st E1, 53°55' N, 17°52' W, 2456-2420 m, 1 spm; st B4, 52°06' N, 45°33' W, 4166-4452 m, 3 spms; THALASSA st W406, 43°55' N, 05°44' W, 400-700 m, 1 spm; LAGARDERE st GCh 51, 44°31' N, 02°10' W, 360-410 m, 1 spm; S of Iceland, 63°01' N, 22°10' W, 577-550 m, 1 spm (coll. Jón Bógason).

Distribution: In the western Atlantic, from 37° N to off Newfoundland, to Iceland and the Azores (depth 200-3000 m), to Norway, from where a single record has been published, southwards along the slope off the British Isles (Farran 1907, Massy 1930:300) to the Bay of Biscay (Vayssière 1896:243) and off Morocco. Depth range 200-4500 m.

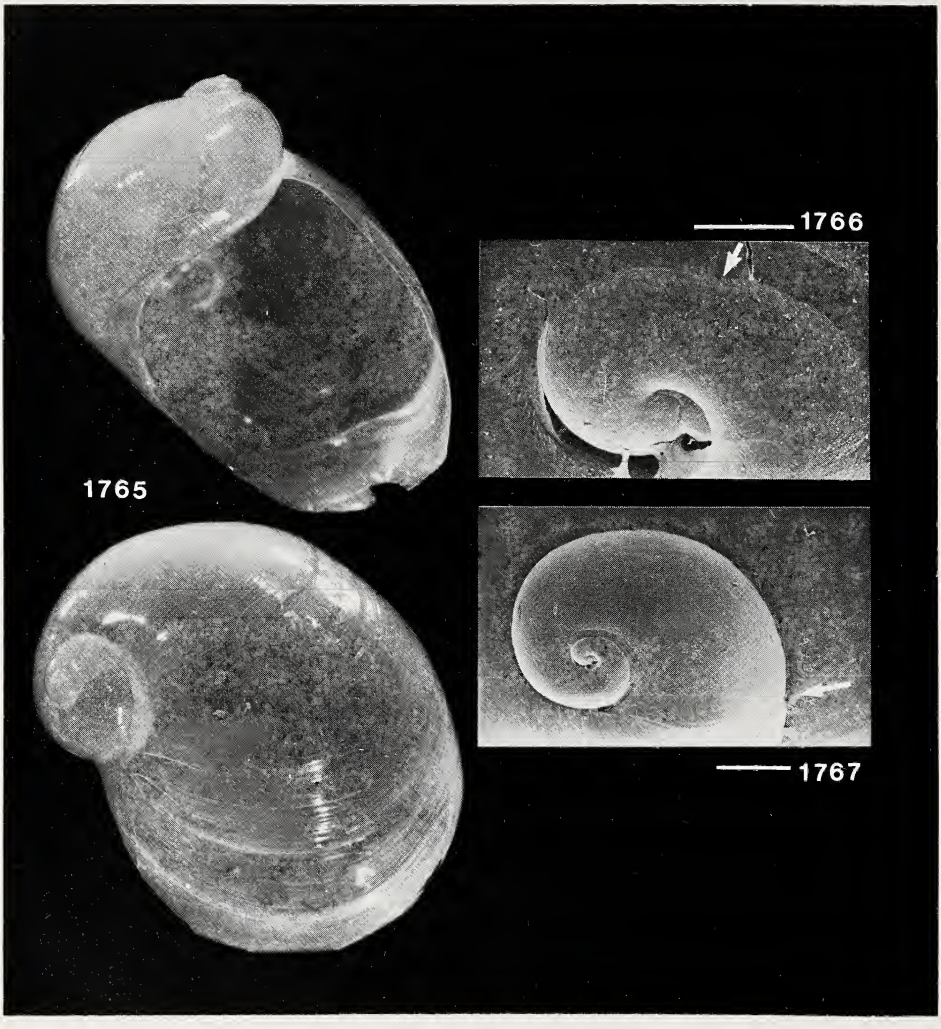
Remarks: We have examined dried specimens of *L. pellucida* & var. *gouldii* identified by Verrill, and they differ from our specimens in being smaller. Of other characters, it is mainly the radula, the shape of the penis, and the shell which still can be examined. The radula and the shape of the penis agree, except in size, with our specimens. The shell was too broken in our specimens to allow comparison.



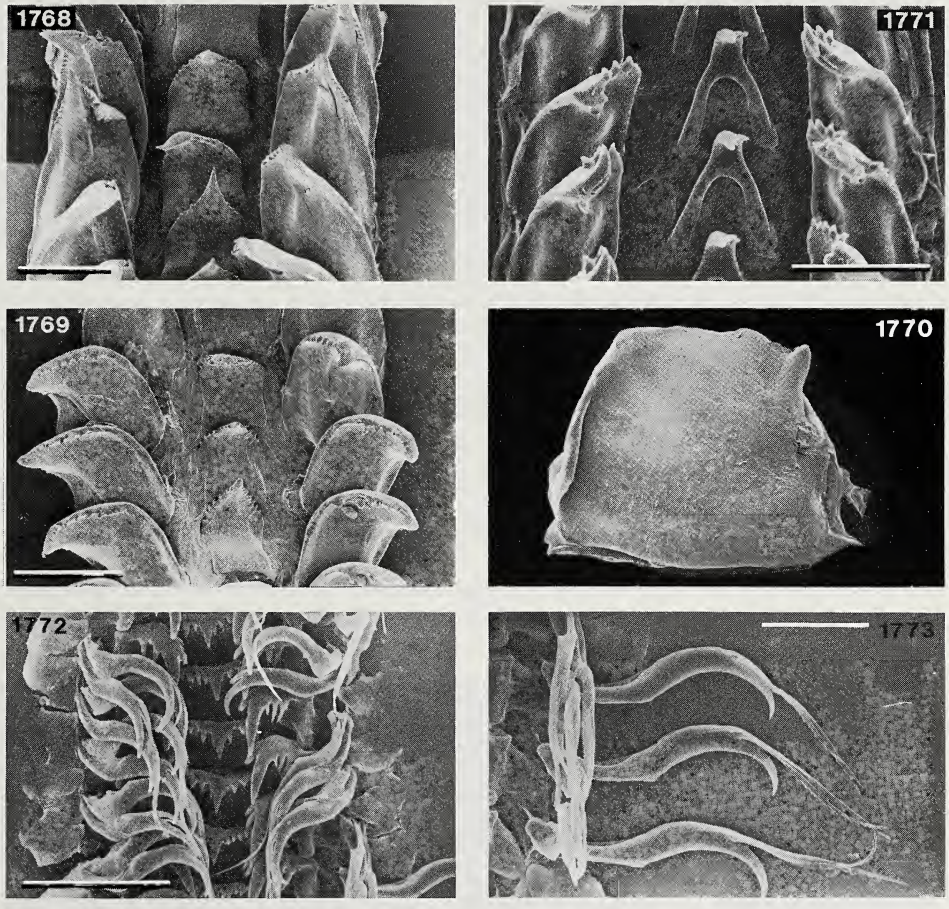
Figures 1763-1764. Cephalic regions of *Lamellaria* and *Calyptoconcha*, showing the position of penis in relation to right tentacle. **1763**, *Lamellaria perspicua*, Tromsö, northern Norway, 30-40 m; scale line 1 mm. **1764**, *Calyptoconcha pellucida*, 48°01' N,07°03' W, 130 m; scale line 2 mm. p = penis, t = tentacle.

Bergh (1887:241-242) supplemented the original description of *L. pellucida* var. *gouldii*, based on material sent to him by Verrill. The males were said to be 12-18 mm long, to have eyes and a very thin shell. This agrees with at least a part of our material.

When Locard (1897) introduced the name *Oncidiopsis aurantiaca*, it was compared only with *O. glacialis* M. Sars, which explains why he described it as new. Recently collected specimens from the vicinity of Locard's type locality differ from Locard's specimen only in the colour of the mantle. This was whitish with brownish speckles in the our new specimens, while Locard supposed it to have been orange.



Figures 1765-1767. *Calyptoconcha pellucida*. **1765**, holotype, diameter 12.8mm (USNM 202846). **1766-1767**, TALISMAN dr 135, protoconch. The arrows indicate the zone of presumed transition between protoconch I and protoconch II (fig. 1766; scale line 100 μm), and between protoconch II and teleoconch (fig. 1767; scale line 0.5 mm).



Figures 1768-1773. Radulae and jaws, Lamellariidae and *Pediculariа*. **1768**, *Calyptoconcha pellucida*, BIACORES st 136, scale line 200 μm. **1769**, *C. pellucida*, NORATLANTE st B4, scale line 200 μm. **1770**, *C. pellucida*, BIACORES st 259, jaw, width 3.3 mm. **1771**, *Lamellaria perspicua*, Calvi, Corsica, scale line 100 μm. **1772-1773**, *Pedicularia sicula*, BIACORES st 240, scale lines 50 μm and 25 m.

The holotype of *M. leptolemma* is a female, 50 mm long, with uncalcified shell and distinct eyes. Bergh (1899) suspected this species to be the same as *pellucida* but introduced the new name because his specimen had tan-coloured mantle. On this character alone, we see no reason why *leptolemma* should be kept as a separate species. Such variations in the colour of the mantle are well known in *Lamellaria perspicua* from shallow water (see e.g. Thompson 1973).

Finally, *L. pellucida* var. *farrani* is based on two 50 mm long females, with thin, calcified shell. Odhner (1926) attributed Vayssière's (1896) and Farran's (1907) records of *L. pellucida* to his new variety.

All animals have the same general appearance, with a thin, fragile (usually broken or decalcified), internal shell. All males have similar penial morphology (Figs 1763-4). The radular morphology is the same in five animals examined (Figs 1768-9). One character, however, has been obser-

ved to vary, namely the eyes. In animals collected in shallow water (200-1000 m) the eyes are well developed. They are reduced in animals from 1000-3000 m, and there is only a barely discernible eye spot in our animals from 4400 m. We have previously not found such a variation from fully developed to nearly absent eyes in any deep-sea gastropod, and this may be an indication that more than one species is involved. However the material is impossible to separate on this character alone.

We are treating all the material examined as a single species, although we are not absolutely certain this is the case. Because the characters of the type material of the nominal species in the synonymy fall within the range of our northeastern Atlantic material, we tentatively treat all the names as synonyms.

Family OVULIDAE

The taxonomic position of *Pedicularia* has recently been reviewed by Gosliner & Liltved (1985) who considered existing anatomical information insufficient to maintain Pediculariidae distinct from Ovulidae. The larval shell morphology (Scheltema 1971, Robertson 1971, Richter & Thorson 1975) of *Pedicularia* supports their view.

Aperiovula juanjosensii Perez & Gomez, 1987 has been described from the Canaries in deep water. It occurs also on the seamounts between Madeira and Portugal in about 200-300 m.

Genus *PEDICULARIA* Swainson, 1840

Pedicularia Swainson, 1840:357. Type species, by monotypy, *P. sicula* Swainson, 1840. Sicily.
Thyreus Philippi, 1844a:92 (not Panzer, 1806). Type species, by monotypy, *T. paradoxus* Philippi, 1844. Sicily.

Remarks

Generic nomenclature: The names *Dentiora* Pease, 1862, *Pediculariella* Thiele, 1925 and *Pediculariona* Iredale, 1935 are generally treated as synonyms or subgenera of *Pedicularia*. We have not considered the taxonomy of these pediculariines from other oceans, but the synonymy seems justified.

Biology: Species of *Pedicularia* are obligate symbionts with stylasterids, a family of calcified hydrozoans (Arnaud & Zibrowius 1979, Zibrowius & Cairns 1992). Records of associations with other hosts taxa were listed by Robertson (1970). We consider them erroneous. As a result of their close association with the hosts, the shells of *Pedicularia* modify their shape after the substrate and are extremely variable, with a shape of the aperture matching the branch on which they are attached. This complicates their taxonomical study.

Species taxonomy: Several names are available for North Atlantic and Mediterranean species of *Pedicularia* and several species are usually recognized (Kobelt 1908, Schilder 1931), although Scheltema (1971) expressed doubts on the specific distinction of eastern and western Atlantic species.

We have tried to test the following two hypotheses:

--(1) There is a single variable species that can parasitize different stylasterid hosts.

--(2) There are several less variable species, each host specific on certain stylasterid taxa.

Zibrowius & Cairns (1992) have revised the northeastern Atlantic and Mediterranean Stylasteridae and listed all occurences of *Pedicularia* from the host. Also when the gastropod has fallen off the host, one can see that it has been there from a scar on the branch (Fig. 1774). The snail deposits a calcareous layer (apparently by its foot), under which the stylasterid skeleton cannot grow in thickness, unlike the surrounding areas. This results in a slight depression, the contour of which fits that of the shell. Generally the crust has prominent crests which considerably enlarge the crust surface and to which the foot of the snail adheres more efficiently. These elongate, irregular hallmarks of *Pedicularia* are easily recognizable and provide information on the occurrence of the snail, even when the stylasterid was already dead when collected.

In the region covered by our revision, Zibrowius & Cairns have recorded scars caused by *Pedicularia* from the following localities and host species:

--The Azores: Scars and snails have been found on *Errina atlantica* Hickson, 1912, traces on *Lepidopora eburnea* (Calvet, 1903) and *Errina dabneyi* (Pourtalès, 1871) (all endemic to the Azores, which are also the type locality of *Pedicularia decurvata* and *P. sicula* var. *sublaevigata*).

--Madeira: Scars found on *Stenohelia maderensis* (Johnson, 1862) (northeastern Atlantic).

--Southwestern Mediterranean and Ibero-Moroccan Gulf: Scars and snails on *Errina aspera* (Linné, 1767) (endemic to this region). (*Pedicularia sicula, Calyptrea polymorpha* and *Thyreus paradoxus* described from the area.)

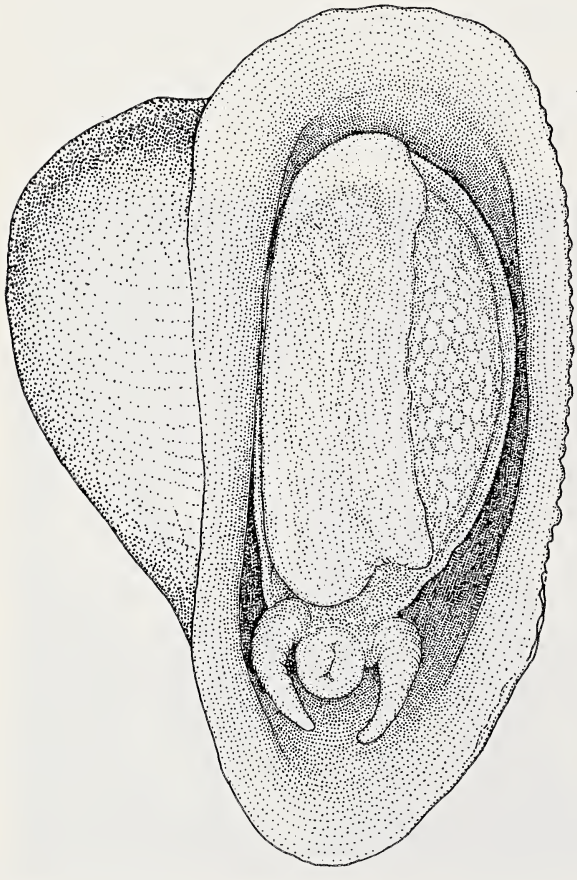
Figure 1774. Colony of *Errina aspera* with two *Pedicularia sicula* in situ, strait of Messina, Sicily. When *Pedicularia* is removed, the characteristic scar on the stylasterid becomes visible (arrows). Height of the colony 22 mm.

--Bay of Biscay: Scars and snails on *Stylaster ibericus* Zibrowius & Cairns (only known from northwestern Spain), scars on *S. erubescens britannicus* Zibrowius & Cairns (a subspecies occurring from the Faroes to west of the British Isles; other subspecies in the northern and western Atlantic) and *Pliobothrus symmetricus* Pourtalès, 1868 (vast northeastern and western Atlantic distribution).

--West Atlantic: Scars have been noticed on *Stylaster complanatus* Pourtalès, 1867, *S. erubescens erubecens* Pourtalès, 1867, *Conopora* sp. and *Crypthelia peircei* Pourtalès, 1867. (*Pedicularia decussata* (Gould, 1855) and *P. albida* Dall, 1881 described from the western Atlantic.)

A reasonable assumption as a result of host specificity, is that a single species of *Pedicularia* only, should be present in the Mediterranean and Ibero-Moroccan Gulf, where a single species of stylasterid is present.

Examination of hundreds of shells from BALGIM st DR40 (Figs 1781-1787), where only *Errina aspera* is known to occur, showed no less variation than all our remaining material. A reduction in



Figures 1775-1776. *Pedicularia sicula*, Strait of Messina, Sicily. **1775**, ventral view of female brooding embryos in cavity extending along the foot (see text), height 8.1 mm. **1776**, embryonic shells (protoconch I) of brooded embryos, scale line 50 μm.

the number of host species does thus not reduce the variation and therefore hypothesis (2) is not likely to be true.

On the other hand, addition of all our remaining Mid- and East Atlantic material did not increase the variation, which is in accordance with hypothesis (1). We therefore favor that explanation.

The ontogenetic development observed in the large sample of empty shells from DR40 can be summarized as follows.

After metamorphosis, the teleoconch is regularly coiled for about 1-1.5 whorls and has a few coarse or many fine (with all intermediates) nodulous spiral cords. At the end of this regularly coiled period, the shell resembles a subadult cowrie and the protoconch is only partly covered but still visible. Some specimens (in material from other stations) apparently do not grow more and their outer lip becomes thickened and crenulated (Figs 1779-1780). Most specimens, however, start a period of extremely irregular growth and the nodulous cords of the regular period generally do not extend to that part of the shell. At the end of this second period the outer lip remains sharp and smooth (Fig. 1786), and the protoconch is completely covered. This difference in exposure of the protoconch was emphasized by Dautzenberg & Fischer (1896) as a character separating *P. sicula* from *P. decussata*, but is obviously a gerontic character.

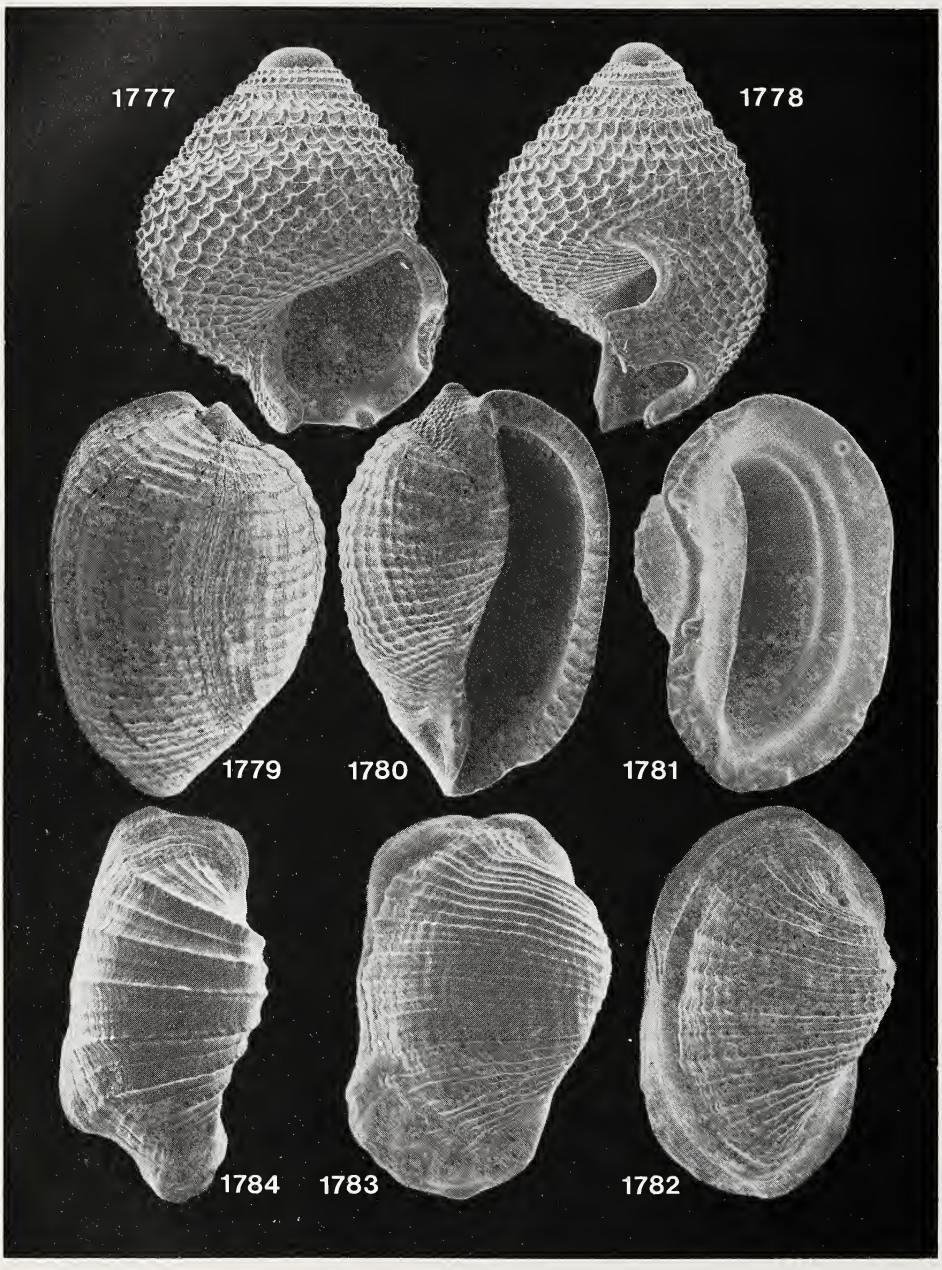
Excellent SEM pictures have been published of larvae taken off Bermuda by Robertson (1971:figs 25-34 [caught in April]) and off Naples by Richter & Thorson (1975:figs 58a-b [March-Apri]). We supplement these with figures of larval shells taken from bottom samples in the Ibero-Moroccan Gulf (Figs 1777-1778). All these larval shells agree in dimensions, shape, and sculpture, which, however, does not exclude that more than one species can be involved. Perhaps more specific is the finely pitted sculpture of protoconch I that is present in both Mediterranean and Bermudean larvae but is absent on protoconch I of *Pedicularia pacifica* Pease, 1865. The different sizes mentioned in the literature do not suggest that different larval species should be involved. Robertson (1971) mentioned 0.6-1.0 mm in the text and figured a larva 625 μm high, from Bermuda. Scheltema (1971) figured a 840 μm high larva from northwest off Bermuda and a 975 μm high larva from off the Azores. Richter & Thorson's (1975) figured larva is 950 μm high. Di Natale & Mangano's (1985) measurements of 30 larvae from the Strait of Messina gave an average height of 714 μm. Our own unmetamorphosed larvae are 650 and 680 μm high. Scheltema (1971) found *Pedicularia* larvae in plankton from the Gulf Stream, the North Atlantic Drift, the Mediterranean, and the North and South Equatorial Currents, and suggested that only a single species was involved.

From the examination of teleoconch and protoconch characters, we therefore conclude that a single species of *Pedicularia* is present in the northeastern Atlantic. All proposed nominal taxa fall within the range of variation of that species. We do, however, refrain from synonymizing the western Atlantic nominal species *P. decussata* with the European species. As noted above, the larval shells are indistinguishable, but the teleoconch of *P. decussata* differs. The sculpture is finely and distinctly reticulate in *decussata*, whereas only spiral cords are present in *P. sicula*, and *P. decussata* has no marked interruption of the sculpture during the phase of irregular growth. We have seen too little material from the western Atlantic (6 spms in 3 lots, USNM; type material of *P. albida* Dall, 1881) to know if these differences are constant.

Pedicularia sicula Swainson, 1840 Figs 1772-1787

Pedicularia sicula Swainson, 1840:357, fig. 44.
Calyptrea polymorpha Calcara, 1842:17.
Thyreus paradoxus Philippi, 1844a:92, pl. 18 fig. 1.
Pedicularia decurvata Locard, 1897:96, pl. 3 fig. 12.
Pedicularia sicula var. *sublaevigata* Locard, 1897:99.

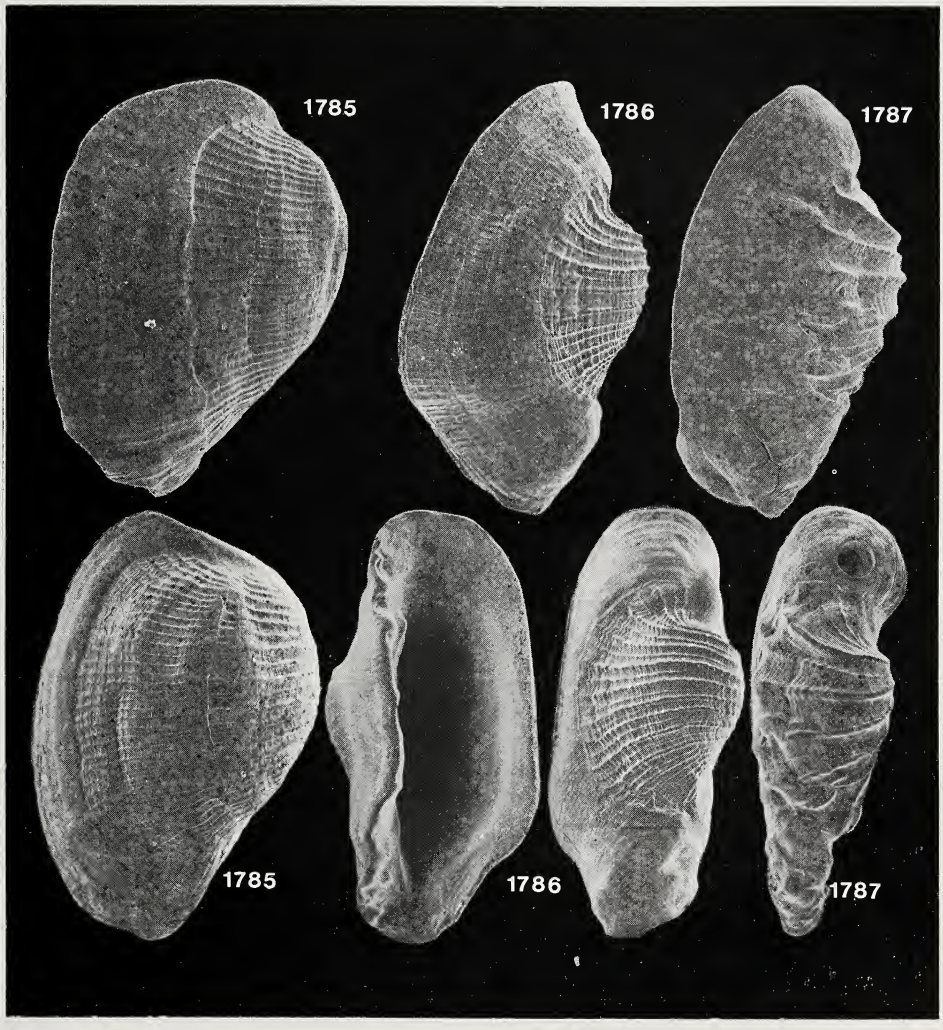
Type materials: P. sicula, lost, not in Manchester Museum (Dean 1936 and C. Pettitt, pers. comm.), not in BMNH (K. Way, pers. comm.); *C. polymorpha*, not known; *T. paradoxus*, not in ZMHU; *P. decurvata*, figured syntype in MNHN.



Figures 1777-1784. *Pedicularia sicula*. **1777-1778**, larval shell from bottom sample, BALGIM st DW57, height 730 μm and 705 μm. **1779-1780**. "Trivia" stage with crenulated outer lip, THALASSA st X363, height 2.3 mm. **1781-1784**, shells of adult sedentary specimens, BALGIM st DR40. **1781-1782**, 6.4 mm. **1783**, 5.9 mm. **1784**, 4.8 mm.

Type localities: P. sicula, Sicily; *C. polymorpha*, "Mare di Messina e dell'Isole Eolie"; *T. paradoxus*, Sicily, "in Corallio nobili"; *P. decurvata*, the type material lacks locality data; Locard (1897) listed material from TALISMAN dr 128, 38°07' N, 27°12' W, 983 m and dr 129, 38°00' N, 27°03' W, 2155-2220 m, the Azores.

Material examined: The figured syntype of *P. decurvata* and:
--Azores. --Azores (without further data), 10 spms (5 brooding females) (IRSN); BIACORES st



Figures 1785-1787. *Pedicularia sicula*, all from BALGIM st DR40, shells of adult sedentary specimens showing variation of sculpture and shape. **1785**, height 4.3 mm. **1786**, 6.9 mm. **1787**, 7.9 mm.

49, 37°56' N, 29°12' W, 215-225 m, 3 spms (brooding females); st 197, 37°51' N, 25°04' W, 815 m, on host, 19 spms (several brooding females), 9 shs; st 240, 37°35' N, 25°32' W, 810-825 m, on *Errina atlantica*, 3 spms (1 brooding female), 1 sh;

--Mediterranean. --Strait of Messina, 100 m, on *Errina aspera*, 3 spms, leg. di Geronimo; Palermo, 2 shs; Isole Lipari, 2 shs; Sicily, 2 spms ex Benoit; no loc., 2 spms (1 brooding female) on *Errina aspera*; Rade d'Hyères, southern France (error! see below), 2 shs (coll. Dautzenberg, IRSN).

--Eastern Atlantic. --CALYPSO st SME1282, Spartel Bank, W entrance to Strait of Gibraltar, 110 m, 2 shs; Spartel Bank, 35°54' N, 06°00' W, 110 m, on *Errina aspera*, 8 spms; AL MOUNIR st B10D3, 35°43' N, 06°21' W, 200 m, on *Errina aspera*, 2 spms; BALGIM st DR37, 36°18' N, 07°15' W, 860-868 m, 6 shs; st DR40, 35°50' N, 06°09' W, 362 m, 50 fresh shs + several hundreds worn shs; st DR49, 35°53' N, 06°33' W, 518-524 m, 34 shs; st DW50, 35°53' N, 06°32' W, 518-526 m, 7 shs; st DR115, 35°48' N, 06°04' W, 332 m, 51 shs; st DR153, 35°56' N, 05°35' W, 568-604 m, 1 sh; THALASSA st X363, 44°06' N, 04°53' W, 545-630 m, 1 sh; st Y430, 44°12' N, 08°41' W, 500 m, on *Stylaster ibericus*, 11 spms (several brooding females); st Y432, 44°12' N, 08°41' W, 515 m, on *Stylaster ibericus*, 2 spms (1 brooding female); st Z435, 48°40' N, 09°53' W, 1050 m, 4 spms (2 brooding females), 2 shs (traces of *Pedicularia* on *Pliobothrus symmetricus* at this station); SEAMOUNT st DE10, 36°27' N, 11°35' W, 500-545 m, 1 sh; st DE98, 35°03' N, 12°55' W, 300-325 m, 1 sh; st DW108, 42°51' N, 11°53' W, 1110-1125 m, 12 shs; st DW111, 42°40' N, 11°36' W, 675-685 m, 47 shs; st DW116, 42°52' N, 11°51' W, 985-1000 m, ca 200 shs; CANCAP st 2.160, 27°36' N, 17°59' W, 550 m, 2 shs.

Distribution: From the northern part of the Bay of Biscay southwards along the continental slope to the Ibero-Moroccan Gulf and into the Mediterranean, as far east as the Strait of Messina and the sill of the Sicilian Channel. (Records from other parts of the Mediterranean are considered erroneous by Zibrowius & Cairns (1992) because there are no stylasterid hosts at these localities). It occurs also on the banks off Spain and Portugal, Madeira, the Azores, and the Canaries. In the Atlantic *P. sicula* is a bathyal species, in the Mediterranean it occurs as shallow as 100 m, in the Strait of Messina, an area of strong currents.

Remarks: Embryos are brooded in a cavity along the right side of the foot (Fig. 1775). Di Natale & Mangano (1985) reported larvae in the mantle cavity of two specimens. Brooding was also reported by Dall in *P. decussata* (1889:238), by Habe (1955) in *P. pacifica* (as *P. stellasteris*), and by Robertson (1971:9) in *P. californica* and *P. sicula*. Based on observations on dried bodies Robertson believed the egg capsules to be brooded in the mantle cavity.

Brooded embryos have a shell consisting of less than one whorl, sculptured by minute pits formed between anastomozing and branching ridges (Fig. 1776). Planktonic veligers have a shell with up to 3.5 whorls with an obliquely reticulate sculpture and three deep sinusigera notches (Figs 1777-1778).

We suspect that *Pedicularia sicula* is a protandric hermaphorodite, with the small "*Trivia*-stage" shells (Figs 1779-1780) corresponding to relatively mobile males that can move on the branches of the host. Some specimens would then change sex and become females. These would get distorted shells during their almost sedentary life on the stylasterid branch. This hypothesis should be tested when a large live-taken population becomes available.

Family NATICIDAE

The family Naticidae contains several deep-water species. They are often difficult to identify, but the keys below will, we hope, be of some help in this. Altogether there are 13 species known from the area and the family has its highest number of species on the upper continental slope. The number of individuals is, however, higher on the deeper bottoms between 1500 and 3000 m. At greater depth they become rarer and we have no specimen from below 5000 m, although Zenkevich *et al.* 1955 (*fide* Wolff 1960) listed naticids from 6860 m. It is, however, likely that these records are based on some naticid-resembling archaeogastropods.

The classification of the Naticidae offers many problems and we are not satisfied with the version given here. The problems are probably the result of their long geological history back to the Triassic (see e.g. Zardini 1978). (We do not share the view of Bandel (1988:270) that none of the St Cassian gastropods belong to the family Naticidae). Furthermore, similarity in ecology between the species, which all are sediment-dwelling, drilling predators (Kabat 1990), has probably led to many convergences. The relationships are also obscured by the fact that it is difficult to use the external morphology of the soft parts due to their contraction when preserved.

Kabat (1991) has just reviewd the supraspecific taxa of the Naticidae and we have profited from his comments on our text and clarifications of problematic names, e.g. *Euspira*.

Radula. There is very little variation in the radula between the species treated here, and it is only some species of *Sinum* which can easily be distinguished generically by radular characters (Marincovich 1977). A somewhat similar radula is also present in the genus *Bulbus*, but since this radular type does not require much change from the normal naticid radula, we believe this to be due to convergence.

Marincovich (1977) revised the Caenozoic Naticidae of the northeast Pacific and used the operculum (calcified/uncalcified) and the shape of the umbilicus and parietal callus as the main characters. He examined the radula of many species, but did not use it for classification.

We have examined the radula of all species treated here and have supplemented this by examination of several other species. Azuma (1961), Dell (1990), Golikov & Sirenko (1983, 1988), Inaba (1976), Majima (1989), Powell (1951), and Troschel (1861) have figured still others.

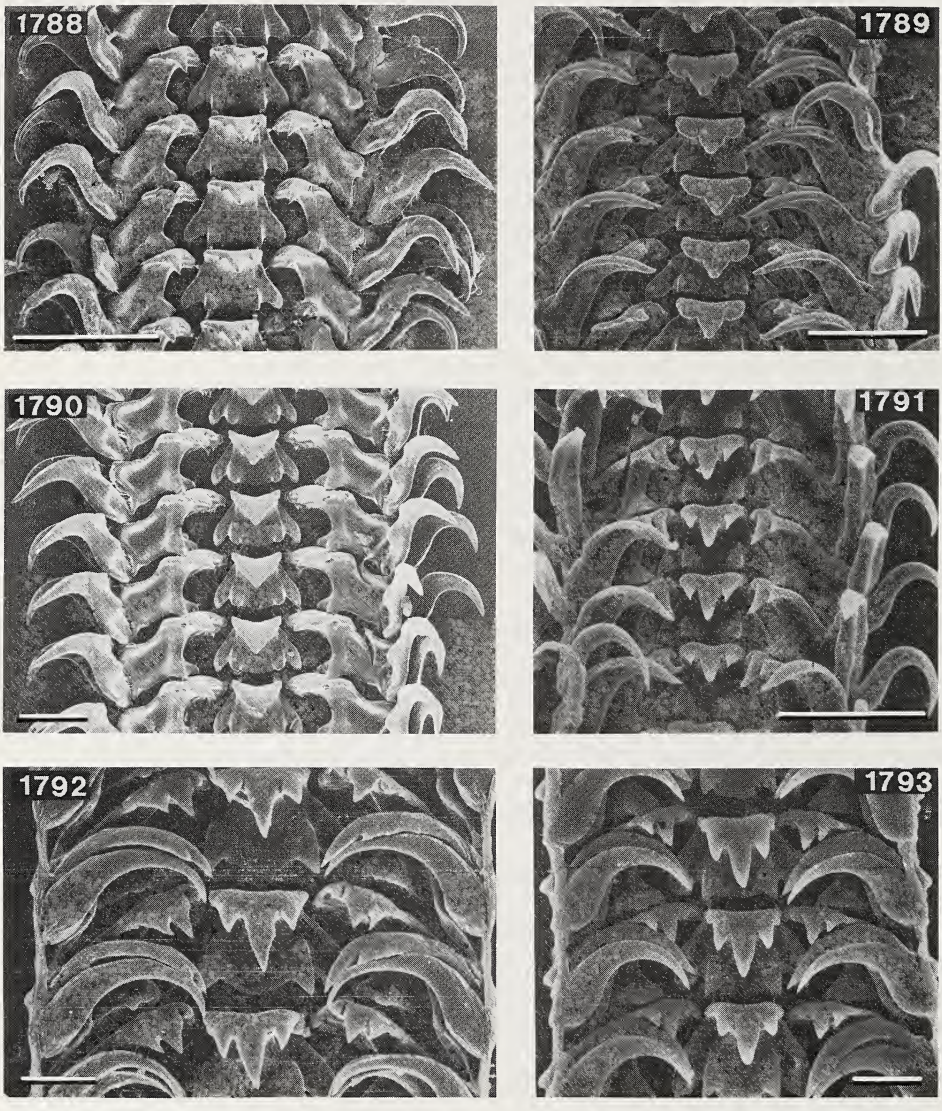
This did not give any unambiguous help for the classification, but some differentiation could be recognized in the central and first marginal tooth

Variation of naticid radulae, with examples

A. First marginal tooth.
1. Simple, claw-shaped. Occurs in but not restricted to *Natica, Cryptonatica, Amauropsis*.
2. With a small denticle on the outside. Occurs in various genera.
3. Forked. Occurs in most genera.
4. With 3 terminal denticles. Only known in *Bulbus*.

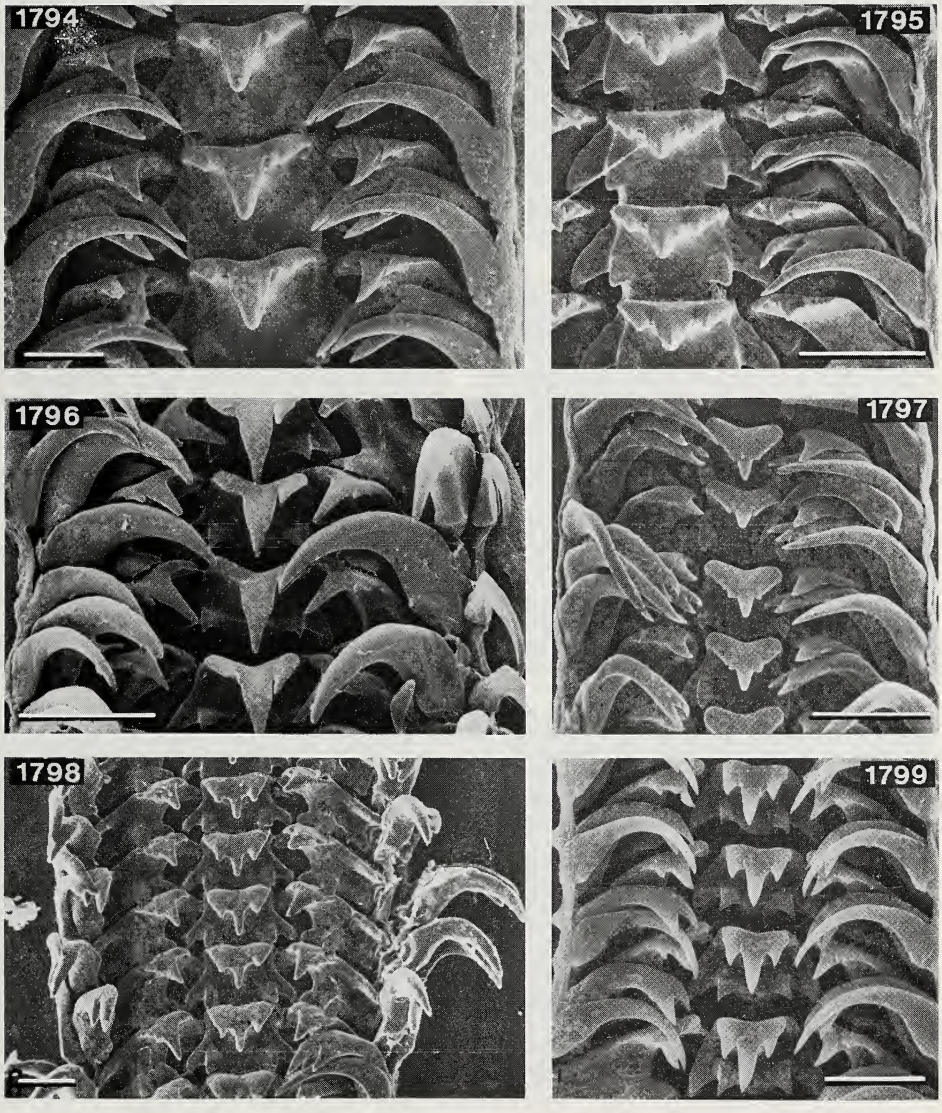
B. Central tooth.
1. Main cusp reduced and smaller than or same size as lateral cusps. *Sinum* (not present), *Neverita, Bulbus*.
2. Semicircular with a single cusp. Some species of *Amauropsis* and *Pseudopolinices*.
3. Main cusp larger than lateral cusps. Occurs in most groups.

Among these characters, it is only the semicircular shape of the central tooth in *Amauropsis* and *Pseudopolinices*, which to some extent has any diagnostic value above species level.

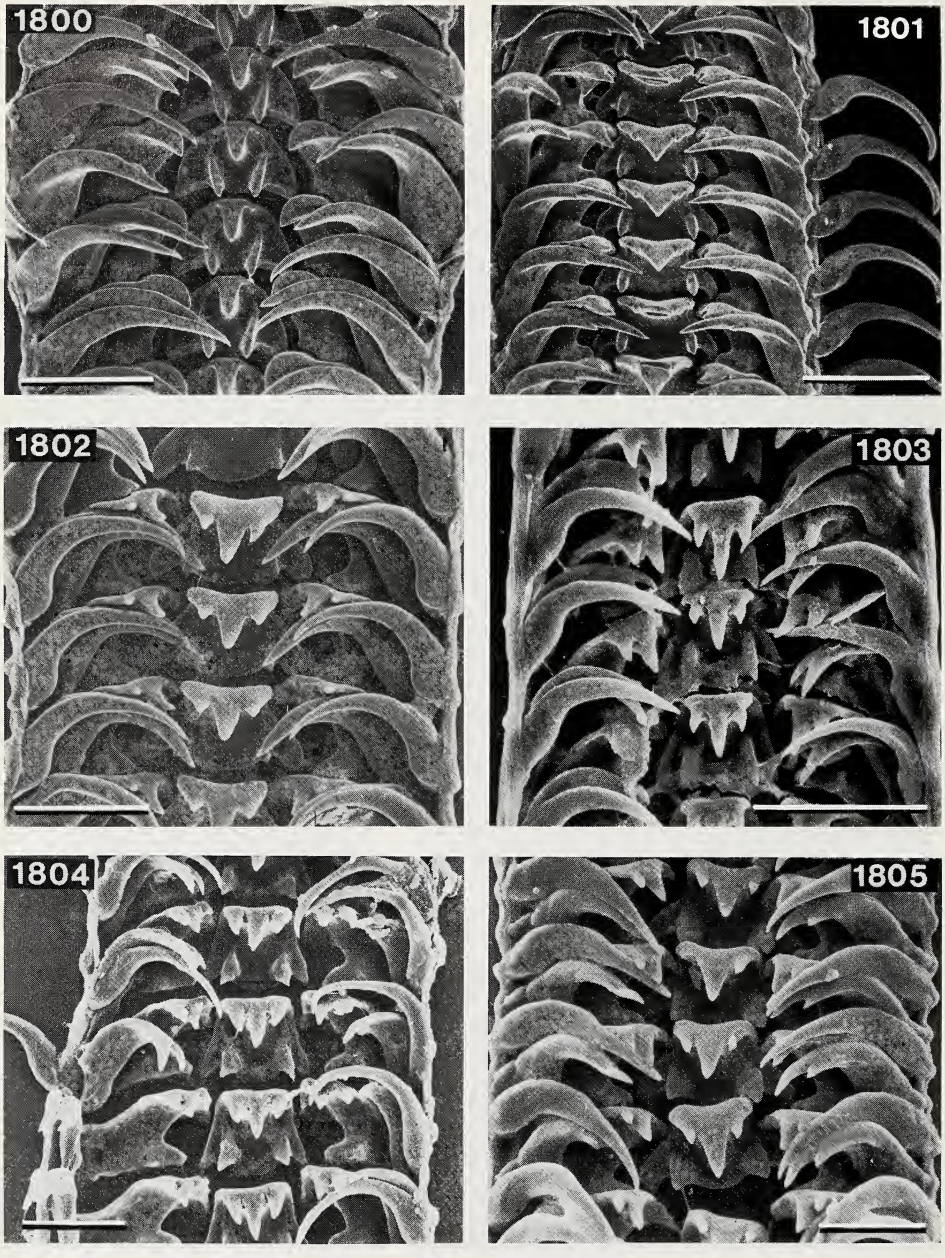


Figures 1788-1793. Radulae of *Cryptonatica*. **1788**, *C. bathybii*, Norwegian Sea. **1789**, *C. affinis*, adult, 15 mm, Tromsö, northern Norway. **1790**, *C. affinis*, adult, 25 mm, Recherche Bay, Vestspetsbergen, 90 m. **1791**, *C. affinis*, adult, 9 mm, Koster area, Sweden, 100 m. **1792**, *C. affinis*, juvenile, 1.5 mm, Korsfjord, western Norway. **1793**, *C. operculata*, adult, 5 mm, THALASSA st W399.

Scale lines 200 μm (1788, 1789, 1790), 100 μm (1791), 20 μm (1793), 10 μm (1792).

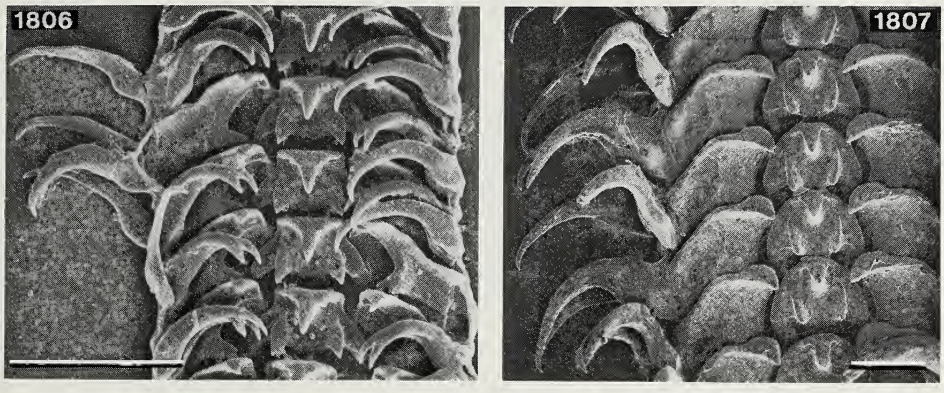


Figures 1794-1799. Radulae of naticids. **1794**, *Tectonatica rizzae*, Azores. **1795**, *T. filosa*, Ceuta, Strait of Gibraltar. **1796**, *Euspira grossularia*, Senegal, 53 m. **1797**, *E. talismani*, holotype. **1798**, *Amauropsis islandica*, locality unknown. **1799**, *A. sphaeroides*, BIOGAS st DS55.
Scale lines 100 μm (1796, 1797, 1798), 50 μm (1795), 20 μm (1794, 1799).



Figures 1800-1805. Radulae of naticids. **1800**, *Amauropsis brassiculina*, lectotype. **1801**, *Polinices fusca*, Bay of Biscay. **1802**, *P. montagui*, Koster Area, Sweden. **1803**, *P. obtusa*, adult, 8 mm, BIOGAS st CP04. **1804**, *P. obtusa*, young, BIOGAS st DS87. **1805**, *P. subplicata*, THALASSA st Z421.

Scale lines 200 μm (1800, 1801), 100 μm (1802), 50 μm (1803, 1804, 1805).



Figures 1806-1807. Radulae of naticids. **1806**, *Polinices subplicata*, DISCOVERY st 9134. **1807**, *Amauropsis brassiculina*, TALISMAN 1883 dr. 83-86.
Scale lines 100 μm (1807), 50 μm (1806).

Ontogenetic changes of the radula: Odhner (1913) pointed out that large, arctic specimens of *Cryptonatica affinis* have only a single main cusp on the central tooth, instead of the three cusps, which are normal in small specimens, especially in the southern part of the distribution. We have verified this by examination of halfgrown and adult specimens from Spitsbergen and northern Norway.

Examination of recently hatched juveniles of *Cryptonatica operculata* showed this even better and revealed that these, contrary to the adults, also have bifurcated first marginals.

A similar examination of two species of *Polinices*, from intermediate depths, *P. obtusa* and *P. pulchella* (Risso, 1826) [= *alderi* (Forbes, 1838)] showed that these also have bifurcated first marginals both as young and adult.

Examination of young specimens of *Neverita josephinia* Risso, 1826 also showed that these have a dominant central and one smaller lateral cusp on each side, instead of three cusps of the same size.

We therefore assume that the unmodified naticid radula resembles these juvenile radulae, in having bifurcated first marginals and tricuspidate centrals, with well developed anterior supports and lateral processes.

If this radular type is kept during the young stage, as it obviously is in the species we have examined, we can explain why e.g. bifurcated first marginals appear among many different groups of naticids, and that this character should not be overestimated. However, deviations from this, like the small cusp on the first marginal tooth, which appears in several similar European species of *Polinices*, e.g. *pulchella, montagui, fusca*, can probably be considered to indicate relationship.

Umbilicus: The development of an elaborate umbilicus is probably an advanced feature since Triassic species either had no umbilicus, but only a fissure like the modern *Amauropsis*, or a very simple one. This can be seen also in species like *Natica hebraea* (Martyn, 1786), where very young specimens have a simple, broad umbilicus with slightly thickened inner lip, not very different from young specimens of *Natica affinis*, which also have an umbilicus when very young, later filled out by a calcareous pad.

Operculum: The operculum has been used extensively for classification of the naticids, starting with grouping them into species with calcified and uncalcified opercula. We agree that the complicated operculum of many shallow water groups of Naticinae certainly is useful for grouping species. At the same time we find it worth to point out that many species with a simple, calcareous opercu-

lum are conchologically very similar to species with corneous operculum, e.g. *Cryptonatica bathybii* and *Amauropsis sphaeroides*, and Dell (1990) suggested not too much emphasis be put on the operculum. There are also species with partly calcified operculum (Powell 1951, Dell 1990).

KEY TO THE NORTHEAST ATLANTIC DEEP WATER GENERA OF NATICIDAE

A. Operculum calcareous ..... D
A. Operculum corneous ..... B

B. Whorls distinctly set off by a deep suture, umbilicus without internal ridges ..... *Amauropsis* (p. 769)
B. Whorls more or less continuous C

C. Umbilicus with internal ridges and furrows ..... *Polinices* (p. 774)
C. Umbilicus simple ..... *Euspira* (p. 767)

D. Umbilicus completely closed by a calcareous callus ..... *Cryptonatica* (p. 758)
D. Umbilicus partly open ..... *Tectonatica* (p. 764)

Genus *CRYPTONATICA* Dall, 1892

Cryptonatica Dall, 1892:362. Type species, by subsequent designation (Dall 1909:85), *Natica clausa* Broderip & Sowerby, 1829 (= *Nerita affinis* Gmelin, 1791). Arctic. (See Remarks.)
Sulconatica Golikov & Kussakin, 1974:294. Type species, by original designation, *Natica janthostoma* Deshayes, 1839. Northern Pacific.
Boreonatica Golikov & Kussakin, 1974:294. Type species, by original designation, *Natica clausa* Broderip & Sowerby, 1829. Arctic. (***Syn. nov.***)

Remarks: Petit (1986) considered that *Natica (Cryptonatica) floridana* Dall, 1892 should be considered the type species of *Cryptonatica*, following Cossmann's (1896) type designation in a review of Dall's paper. We are not convinced that this view is correct since Dall introduced *Cryptonatica* with the words: "....*Cryptonatica* Dall for those forms with a smooth calcareous operculum.....*N. clausa* B.and S., *N. russa* Gould, *N. pusilla* Say etc." (p. 362). *Natica floridana* is not mentioned here. A few pages later (p. 366) Dall described *N. floridana* and commented: "This species probably belongs to *Cryptonatica*, although the operculum has not turned up." We therefore consider Cossmann's selection invalid according to IZCN article 67(g). Evidently also Cossmann had a similar feeling since he later (1925:120) considered *N. clausa* the type species, as did Dall himself (1909:85).

The species of *Cryptonatica* are characterized by the umbilicus being completely covered by a solid calcareous pad, which along its free side is demarcated by a semicircular furrow, filled by less solid calcareous material. The operculum is calcified and the first marginal tooth is simple, without denticles or teeth in adult specimens. The central tooth has very poorly developed lateral cusps in adult specimens.

The larval shell of species of *Cryptonatica* is difficult to interpret. We have dissected out embryos of *C. affinis* from egg capsules (Figs 1817-1821). They consist of 1.25 whorls and have a diameter of about 1.1 mm (corresponding to a visible diameter of 0.5 mm at the apex of a specimen with a teleoconch, which partly conceals the larval shell). That corresponds with the smallest free-living specimens we have found. But, the apex of adult specimens from the same area does not have the first 1.25 whorls of the spire demarcated. The first noticeable scar comes after about 2.2 whorls, corre-

sponding to a visible diameter of 1.5 mm. In *C. operculata*, of which we have not seen egg-masses or very young specimens, the demarcated part of the apex comprises 1.4-1.6 whorls and has a diameter of 1.4 mm.

KEY TO THE SPECIES OF *CRYPTONATICA*

A. Height of aperture <65% of total height, whorls shouldered ..... *C. bathybii* (p. 759)
A. Height of aperture >65%, whorls not shouldered ..... B

B. Diameter of first half whorl 0.6-0.7 mm larval whorls weakly convex, operculum with a furrow along outer edge ..... *C. operculata* (p. 759)
B. Diameter of first half whorl <0.5 mm larval whorls distinctly convex, operculum without furrow along outer edge ..... *C. affinis* (p. 763)

Cryptonatica bathybii (Friele, 1879)
Figs 1788, 1808-1809, 1829, 1889-1890

Natica bathybii Friele, 1879:272.
Natica bathybii: Bouchet & Warén 1979a:224, figs 11A-B, 44.
Cryptonatica (Sulconatica) bathybia: Golikov & Sirenko 1988:20 (misspelling).

Type material: Syntypes in ZMB.

Type locality: Not designated, NORWEGIAN NORTH ATLANTIC Exp, west and southwest of Spitsbergen, st 312, 74°54' N, 14°53' E, 1203 m, and st 353, 77°58' N, 05°10' E, 2438 m.

Material examined: The material listed by Bouchet & Warén (1979a:225), Odhner (1913:24) and Friele & Grieg (1901:70) and --INGOLF Exp st 113, 69°31' N, 07°06' W, 2465 m, 6 shs (ZMC).

Distribution: The bathyal and abyssal parts of the Norwegian and Greenland Seas, 150-3000 m. Glacial fossil in Sweden (Uddevalla).

Remarks: This species was treated in some detail by Bouchet & Warén (1979a). The shell is very similar to *Amauropsis sphaeroides* (Figs 1833-6), but that species has a wide, simple umbilicus and uncalcified operculum. The umbilical callus is poorly developed in adult specimens of *C. bathybii* and not present at all before a size of 5-10 mm.

Cryptonatica operculata (Jeffreys, 1885)
Figs 1793, 1813-1816, 1839, 1845, 1878, 1892-1893, 1907

Natica operculata Jeffreys, 1885:34, pl. 4 figs 7-7a.
Natica notabilis Jeffreys, 1885:31, pl. 4 figs 1-1a.
NOT *Tectonatica operculata farolita* Nordsieck, 1973:10, fig. 10.

Type materials: N. operculata, lectotype USNM 188374, paralectotypes BMNH 1885.11.5.2406, 2365-67, 2327-2329, also USNM 188373, 188375, 878701; *N. notabilis*, holotype BMNH 1885.1.5.2342; *T. operculata farolita*, 1 syntype from Meteor st D1, 12 syntypes from Ibiza, in SMF, all very young *Natica dillwyni* Payraudeau, 1826.

Type localities: N. operculata, not designated, Ibero-Moroccan Gulf and Adventure Bank, Mediterranean, 160-700 m; *N. notabilis*, PORCUPINE Exp 1870 st Cape Sagres, SW Portugal, 82-106 m; *T. operculata farolita*, Ibiza, Baleares, 50 m and Aegean Sea.

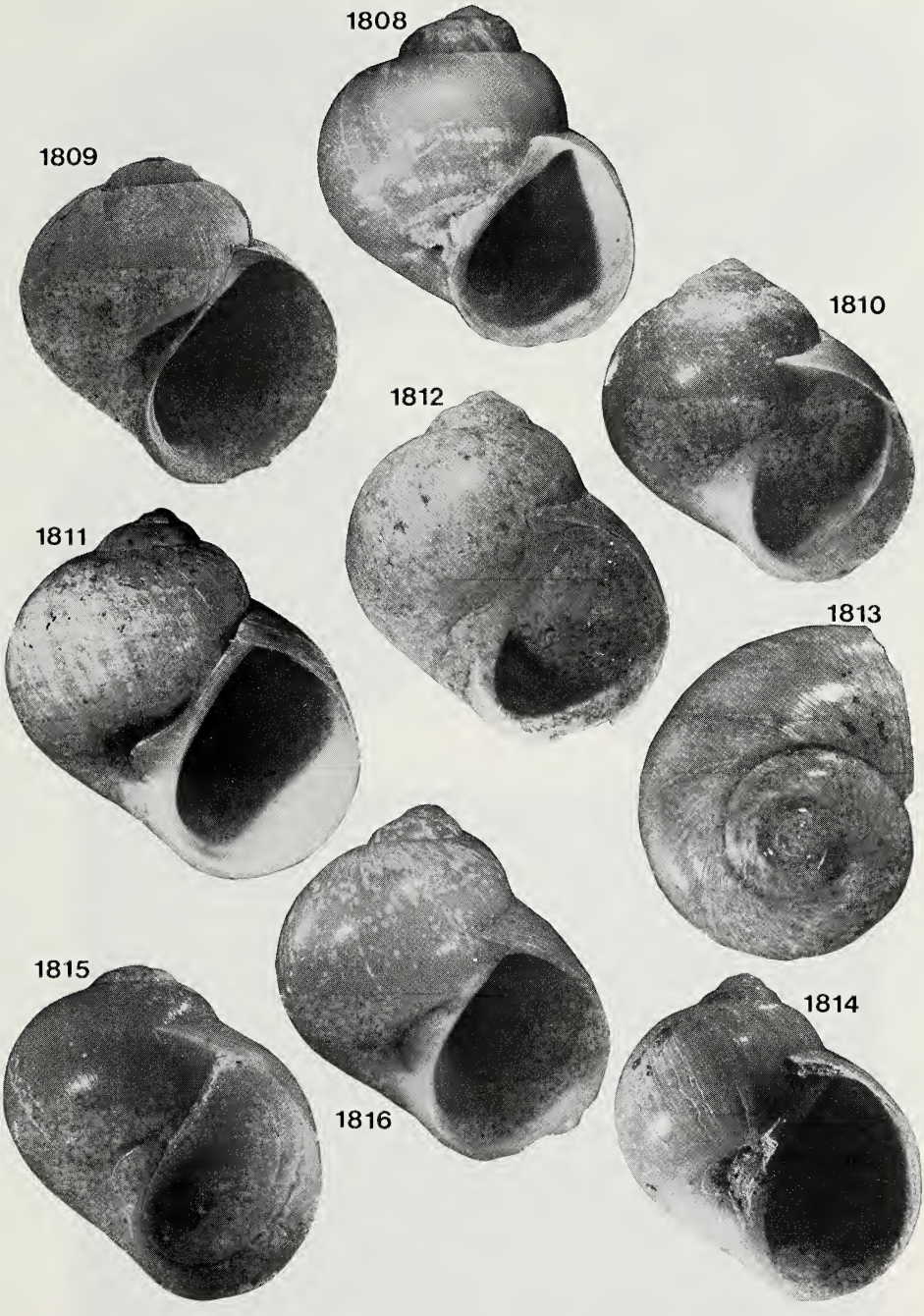
Material examined: The types and THALASSA st W399, 43°48' N, 05°11' W, 210-165 m, 1 sh; st X362, 40°07' N, 04°51' W, 600-585 m, 1 sh; st Y378, 41°31' N, 09°16' W, 1000 m, 1 sh; st Y403, 40°37' N, 09°20' W, 435 m, 1 sh; st Z447, 48°47' N, 11°13' W, 1500 m, 1 sh; TRAVAILLEUR 1880 or 1882 dr 2, north of Spain, 600-1000 m, 2 shs; --BALGIM st DR115, 35°47' N, 06°04' W, 332 m, 1 sh; st DR130, 35°25' N, 04°19' W, 145 m, 1 sh; st DR153, 33°55.8' N, 05°35.3' W, 568-604 m, 3 shs; st DR22, 36°35' N, 07°24' W, 462-472 m, 2 shs; st DR37, 36°18' N, 07°15' W, 860-868 m, 22 shs; st DR40, 35°50' N, 06°09' W, 362 m, 66 shs; st DR49, 33°53' N, 06°33' W, 518-524 m, 21 shs; st DW157, 36°21' N, 07°56' W, 1108 m, 1 sh; st DW20, 36°36' N, 07°24' W, 450-454 m, 2 shs; st DW50, 35°53' N, 06°32' W, 518-526 m, 4 shs; PORCUPINE Exp 1870 st 27, 36°37' N, 07°33' W, 586 m, 2 shs (USNM 188374); st 28, 36°29' N, 07°16' W, 553 m, 4 shs (USNM 188373); st 28a, 36°29' N, 07°16' W, 520 m, 3 shs (USNM 188375); st Cadiz, Ibero-Moroccan Gulf, 703 m, 2 juv. shs (coll. Sykes, BMNH); SEAMOUNT st CP30, 36°44' N, 11°23' W, 1940-2075 m, 2 shs; st DE39, 36°40' N, 14°16' W, 207-222 m, 1 sh; st DE48, 36°48' N, 14°32' W, 1350-1360 m, 1 sh; st DE98, 35°03' N, 12°55' W, 300-325 m, 10 shs; st DW111, 42°40' N, 11°36' W, 675-685 m, 2 shs; st DW116, 42°52' N, 11°51' W, 985-1000 m, 6 shs; st DW21, 36°35' N, 11°28' W, 460-480 m, 1 sh; st DW37, 36°42' N, 14°18' W, 255-270 m, 3 shs; st DW38, 36°42' N, 14°17' W, 235-245 m, 25 shs; st DW43, 33°45' N, 14°17' W, 260-285 m, 15 spms; st DW45, 36°46' N, 14°18' W, 315-335 m, 5 shs; st DW60, 36°43' N, 14°17' W, 240-255 m, 11 shs; st DW61, 36°40' N, 14°16' W, 200-205 m, 50 shs; off southeastern Spain, BANNOCK B74 st 3, 37°39' N, 00°01' W, 260-940 m, 2 shs.

Distribution: From the Bay of Biscay southwards to the Ibero-Moroccan Gulf, and into the Mediterranean (Sabelli & Spada 1977, Cecalupo & Giusti 1988 as *Tectonatica affinis*). Depth range 200-2000 m.

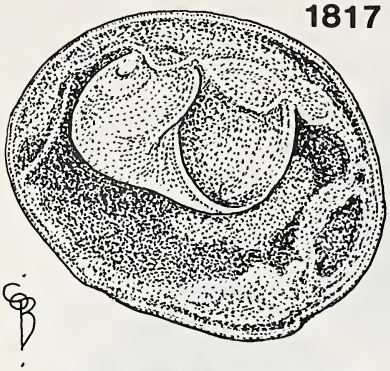
Remarks: We distinguish *C. affinis* (Figs 1810-2), which in the southern part of its distribution occurs only in deep water, and the more southern *C. operculata* (Figs 1815-6), from intermediate depths. Reliable identification of specimens from the area where the two species overlap (the Bay of Biscay and surroundings), can be done only when the larval shell is preserved or the operculum is present. The preservation of the larval shell, however, needs not be perfect. The diameter of the initial half-whorl is about 0.6-0.7 mm in *C. operculata* (Figs 1839, 1845) and 0.4-0.5 mm in *C. affinis* (Figs 1840, 1846) and this can be measured also in somewhat worn specimens. Another difference is that the whorls of the larval shell are unusually flat in *C. operculata* (flatter than in *Polinices montagui* or *pulchella*), while they are more convex in *C. affinis*. The operculum of *operculata* (Fig. 1907) has a fairly distinct furrow along the outer edge, while affinis (Fig. 1905) has no trace of this furrow.

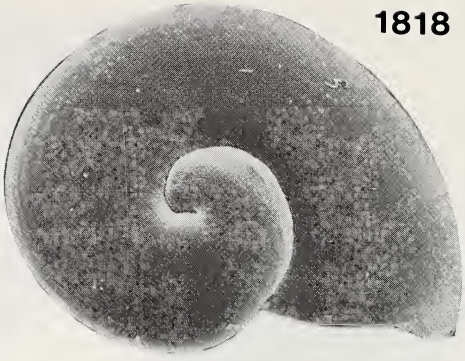
The larval shell of *C. operculata* is similar enough to *C. affinis* to allow inference of encapsulated development without free-swimming veligers, presumably hatching from typical egg collars (*C. affinis* described by Thorson 1935).

One shell from the Bay of Biscay (THALASSA st Z396, 47°33' N, 07°06' W, 511 m, Figs 1813-4) differs distinctly in having a larval shell of about 2.5 whorls and of a diameter of 1.8 mm. This specimen also has a proportionally taller spire than normal. It is likely that this is a fossil specimen since there are grains of pyrite attached to the shell.



Figures 1808-1816. Genus *Cryptonatica*. **1808**, *C. bathybii*, NORBI st CP17, 17.7 mm. **1809**, *C. bathybii*, Norwegian Sea, 5.1 mm. **1810**, *C. affinis*, Tromsö area, northern Norway, 12.1 mm. **1811**, *C. affinis*, Koster area, Sweden, 12.1 mm. **1812**, *C. affinis*, Quarternary fossil, Uddevalla, Sweden, 30 mm. **1813-1814**, *C.* aff. *operculata*, THALASSA st Z396, 7.3 mm. **1815**, *C. operculata*, THALASSA st W399, 5.0 mm. **1816**, *C. operculata*, BALGIM st DW20, 11.0 mm.


1817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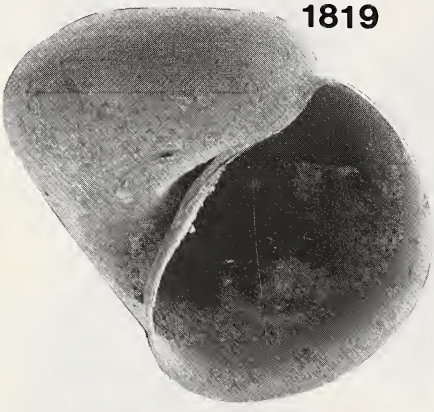
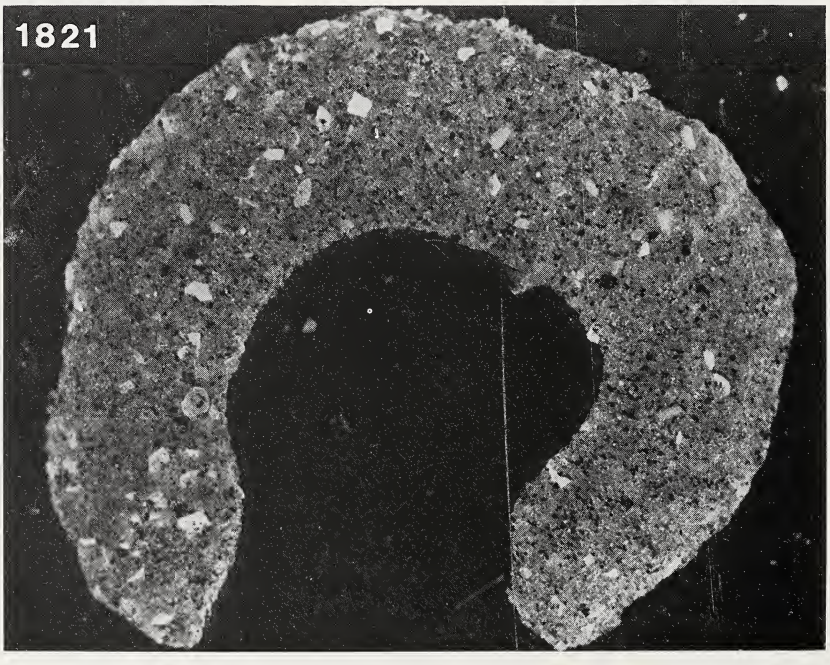

1819

1820


1821

Cryptonatica affinis (Gmelin, 1791)
Figs 1789-1792, 1810-1812, 1817-1821, 1840, 1846, 1877, 1891, 1905

Nerita affinis Gmelin, 1791:3675.
Natica clausa Broderip & Sowerby, 1829:372.
Natica consolidata Couthouy, 1838:89, pl. 3 fig. 14.
Natica septentrionalis Möller, 1842:80.
Natica clausa forma *elatior* and *normalis* Middendorff, 1849:420.
Natica clausa forma *depressior* Middendorff, 1851:209.
Natica clausa var. *minor* Philippi, 1852 (in 1849-53):99, pl. 14 fig. 6.
Natica affinis var. *vittata* Jeffreys, 1877:318.

Type materials: N. affinis, not seen, not in ZMC; *N. clausa*, presumably in BMNH, not seen; *N. consolidata*, MCZ 154831, not seen; *N. septentrionalis*, lectotype designated by Marincovich (1977) and 3 paralectotypes in ZMC, 1 paralectotype SMNH 3808; *N. vittata*, 3 syntypes USNM 189665.

Type localities: N. affinis, Iceland; *N. clausa*, unknown; *N. consolidata*, coast of New England; *N. septentrionalis*, western Greenland; *N. vittata*, VALOROUS Exp st 4, off Greenland.

Material examined: The types of *N. septentrionalis* and --NORBI st CP11, off Tromsö, 350 m, 1 spm; --Norway, Lofoten, off Skjomen, 1 spm (SMNH); western Norway and Swedish west coast, 80-600 m, 70 samples with 350 spms (SMNH, leg. A. Warén); DISCOVERY st 9779, 49°22' N, 12°49' W, 1398-1404 m, 2 shs; st 10112#2, 50°25' N, 13°20' W, 2640-2650 m, 1 spm; st 9753#7, 50°55' N, 12°11' W, 1942 m, 10 spms; --THALASSAst Z447, 48°47' N, 11°13' W, 1430-1550 m, 1 sh; --st Z409, 47°43' N, 08°02' W, 1035-1080 m, 1 sh; BIOGAS st CP01, 47°35' N, 08°39' W, 2245 m, 5 shs; CHALLENGER II, st 155, 48°27' N, 10°20' W, 1330 m, 1 spm (RSM).

Distribution: Arctic circumpolar in shallow water, 0-200 m; in the East Atlantic it descends in deeper water south of Lofoten, in the West Atlantic it does the same in the New England region. It reaches south to the Bay of Biscay and North Carolina and occurs there in depths between 1000 and 2500 m.

Remarks: We use Gmelin's name which has 38 years priority over *clausa*. Marincovich (1977:415) was not certain about the interpretation of Gmelin's name, but Gmelin referred to Müller's (1776) description of Icelandic specimens, where it is clearly stated that the umbilicus is closed and that it was found on the shores. There is only one naticid in Iceland that fits this, viz. *clausa* and this change of name is unavoidable, especially since the name *affinis* has been in regular use, by many authors as a distinct species (G.O. Sars 1878, Harmer 1921, Abbott 1974).

Cryptonatica affinis resembles *operculata*, and the differences are described under that species.

Golikov & Sirenko (1983, 1988) distinguished *C. septentrionalis* as a distinct species. We have examined Möller's type material in SMNH and ZMC, but have not been able to find any persistent differences.

Figures 1817-1821. *Cryptonatica affinis*, egg mass and larvae from egg masses. **1817**, egg capsule, Bergen area, Hjeltefjord, 70-80 m, diameter 2.2 mm. **1818**, larva from same egg capsule, diameter 1.1 mm. **1819-1820**, larvae, Berufjord, northern Iceland, 1.1 and 1.2 mm. **1821**, egg mass, Tromsö northern Norway, diameter 24 mm.

There is, however, a tendency that specimens from shallow water have a higher spire (G.O. Sars 1878, Odhner 1913, and pers. obs.) and that southern specimens (western Norway and southwards) are smaller and have a higher number of whorls than arctic specimens of the same size. Southern specimens also have a proportionally more slender radula (Odhner 1913). Also their spawning differs, see below. We do therefore not rule out the possibility that if more material from various depths in northern Norway becomes available, it will reveal that two species are involved, a large northern shallow-water and a small more southern deep-water species.

Thorson (1935) said that *Cryptonatica affinis* and *Euspira pallida* (Broderip & Sowerby, 1829) have exactly the same larval development. Our examinations of egg capsules show a clear difference. Arctic specimens of *C. affinis* have normal naticid egg collars (Fig. 1821). In *C. affinis* the earliest stage with a fully calcified shell consists of half a whorl, diameter 200-300 μm. During the continued life inside the capsule the larva forms almost one additional whorl using the yolk as nourishment and hatches at a size of 1.1 mm (Figs 1819-1820). In *E. pallida* the ontogeny leads directly to a large young of 1.2 whorls and a diameter of 1.6-2.2 mm.

Southern specimens of *C. affinis* differ in not producing egg-collars, but simple egg-capsules (Fig. 1817), with a simple transparent wall. Warén has found these in western Norway, a few times, November to March, in 70-300 m depth. Not one egg collar or a piece thereof was found in the area. The development is identical to arctic specimens and the youngs hatch at the same size and with the same number of whorls. This difference in spawning contributes to our opinion that more than one species may be involved in *C. affinis*.

Schileyko (1977) gave some anatomical information.

We have not included the North Pacific synonyms (see Marincovich 1977).

Genus *TECTONATICA* Sacco, 1890

Tectonatica Sacco, 1890:33. Type species, by monotypy, *Natica tectula* Sacco, 1890 (ex Bonelli MS). Italy, Pliocene.

Remarks: We have preferred to keep *Tectonatica* as a genus, differing from *Cryptonatica* in not having the umbilicus completely closed by the callus (Fig. 1894).

The Recent form corresponding to *T. tectula* is said to be *Natica filosa* Philippi, 1845 (Pavia 1980:259) (Figs 1795, 1824, 1843, 1880, 1894, 1906), a species resembling *T. rizzae*, but differing in having an solid, semilunar umbilical callus which closes most of the umbilicus, not a simple, reflected inner lip covering it as in *rizzae* (Figs 1895-6).

The placement of *Natica rizzae* in *Tectonatica* is certainly open to discussion, but we have placed it here mainly to draw attention to the similarities between *rizzae* and *filosa*.

Tectonatica rizzae (Philippi, 1844)

Figs 1794, 1822, 1823, 1841-1842, 1879, 1895-1896, 1908

Natica rizzae Philippi, 1844b:108.
Natica rizzae: Philippi 1845:42, *Natica*, pl. 2 fig. 5.
Natica pyrrhosticta Dautzenberg & Fischer, 1896:458, pl. 19 fig. 14.
Natica pyrrhosticta: Dautzenberg 1927:142, pl. 4 fig. 15.
Natica settepassii Gaglini in Settepassi, 1985:*Natica* p. XXXIII, pls 9-10.

Type materials: N. rizzae, location of Philippi's material not known, not in Berlin (Moran *et al.* 1989, and pers. obs.), neotype here selected, the holotype of *N. settepassii* in Museo di Zoologia, Roma; *N. pyrrhosticta*, lectotype, here selected, the specimen figured in the original description,

in MOM; *N. settepassii*, holotype in ZMR, not seen.

Type localities: N. rizzae, off Livorno, Italy (ICZN art.75f); *N. pyrrhosticta*, MONACO Exp st 198, 38°26' N, 28°39' W, 800 m; *N. settepassii*, off Livorno, Italy, from fishermen.

Material examined: The types of *N. pyrrhosticta* and CAPBRETON 88 st DR29, 43°47' N, 02°01' W, 165 m, 1 sh; MONACO Exp st 553, 37°43' N, 25°05' W, 1385 m, 4 shs (MOM); Azores, Fayal, 55-140 m, 40 spms (SMNH); Azores, 2 shs (SMNH); Azores, Sao Miguel, Ponta Delgada, 18 m, 6 spms, 35 shs (SMNH); BIACORES st 89, 39°04.5' N, 28°07.5' W, 358-406 m, 1 sh; --JOSEPHINE Exp 1869, Josephine Bank, 198-216 m, 1 sh (SMNH); BALGIM st DR118, 35°48' N, 05°12' W, 352 m, 1 sh; st DR133, 35°26' N, 04°17' W, 195 m, 1 sh; st DW134, 35°26' N, 04°17' W, 205 m, 2 spms; -- st DW136, 35°26' N, 04°18' W, 298 m, 2 shs; J.CHARCOT Madere, st 29, 2 miles from Cima, 300-340 m, 1 sh; TALISMAN 1883 ?dr 71, 25°39' N, 15°58' W, 640 m or ?dr 90, 21°51' N, 17°28' W, 175 m (confused labelling) 2 shs, det. *N. nana*; ARCHIMEDE 1969 st AC6, 37°55' N, 25°55' W, 720-1730 m, 1 sh.

Distribution: The southern part of the Bay of Biscay south to the Cape Verde Islands (Moran *et al.* 1989), the Mediterranean, the Azores and Madeira, in 20-400 m, occasionally deeper.

Remarks: We can see no difference between our material from the Azores (Fig. 1823) and the European coasts (Fig. 1822), and consider the populations to belong to the same species.

The problems around the name *rizzae* in the literature evidently starts with Philippi's (1853:156) inclusion of *rizzae* in group "II. Operculo corneo, aperturam aequante" in his classification of the genus.

This classification seems, however, to be based on an assumption. The operculum is not mentioned in the description, and among the species with corneous operculum, Philippi also placed, for example, *Natica adansoni* de Blainville, 1825, *N. filosa* and *N. tecta* Anton, 1838, species known to have a calcareous operculum and of which he figured correctly identified shells. We assume that Philippi had inferred that they should probably have a corneous operculum, from similarity to species he knew to have such an operculum.

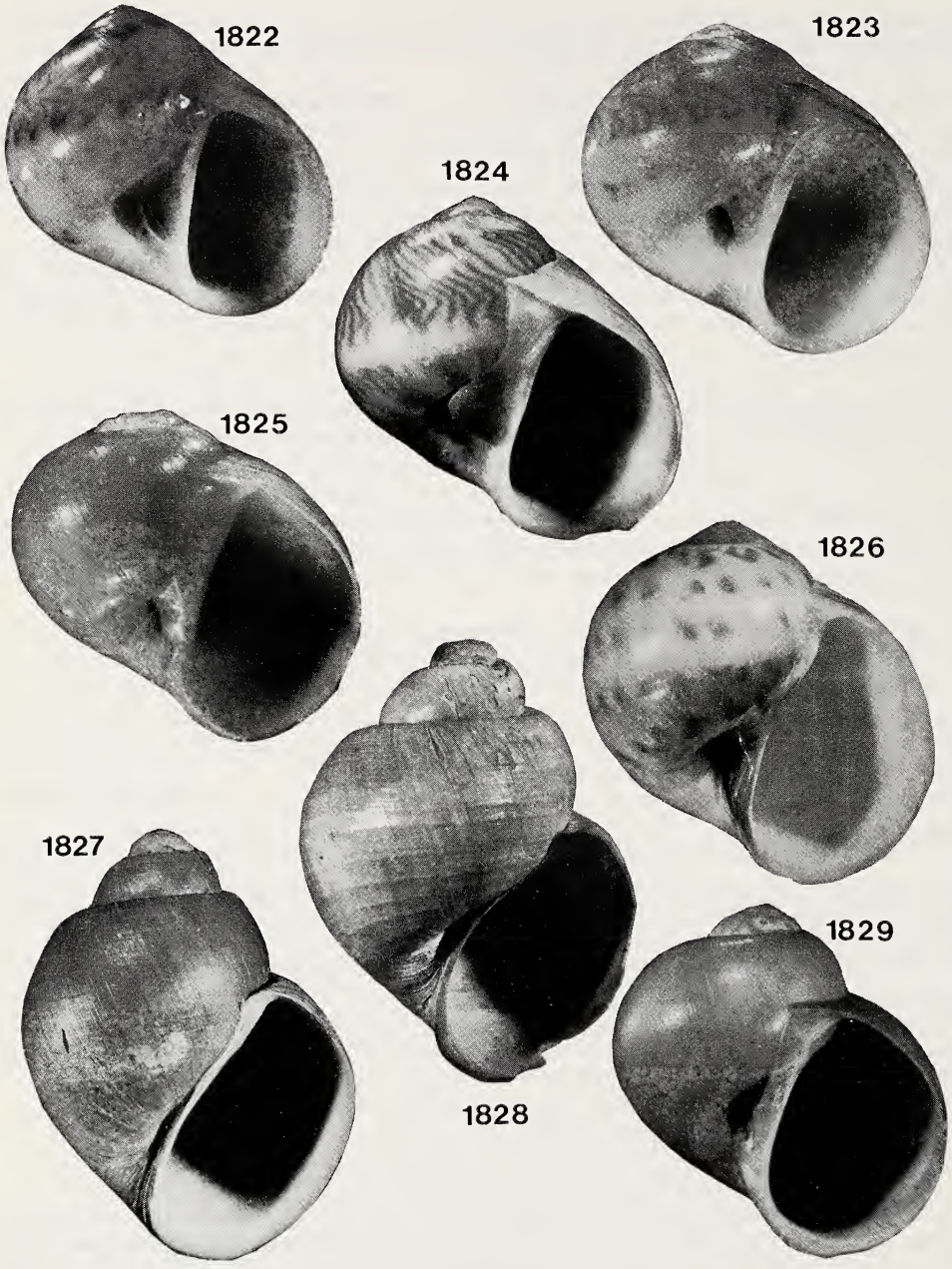
Philippi's classification of *N. rizzae* among the species with a corneous operculum misled many authors from Kobelt (1886:67, 69) and onwards. The classical authors who had access to specimens of this evidently very rare species (in the Mediterranean) seem to have identified it as we do. So did Pallary, judging from a specimen sent to Monterosato and figured by Settepassi (1985, Naticidae plate 9), so did also "Il maestro" himself judging from two specimens sent to MNHN, and so did Dautzenberg (1891:13, pl. 16 figs 14-17) who identified specimens from the Bay of Biscay.

Comparison of Philippi's good figure (1845, 1853) with all Mediterranean naticids, leaves it beyond doubt that *N. rizzae* was based on the same species as *N. settepassii*. The colour patterns are identical, down to the brown umbilical edge of the otherwise white callus. The shape of the callus, obliquely demarcating the umbilicus can not be distinguished. The holotype of *N. settepassii* is more depressed than Philippi's figured specimen, which agrees better with Settepassi's figure of Pallary's specimen but is still well within the range of variation indicated by our material.

Natica rizzae is not a true deepwater species, but we have treated it here since *N. pyrrhosticta* was described from deep water.

Tectonatica rizzae bears some resemblance to *T. filosa* (Philippi, 1845) (Fig. 1824), but the latter has more irregularly undulating colour markings and a rounded callus, which almost completely closes the umbilicus (Fig. 1894), except a deep fissure around the callus. Both species have a multispiral larval shell of about 2.5 whorls with no sharp demarcation of protoconch I or II (Figs 1841-3).

Nordsieck's record of *T. pyrrhosticta* from Israel (1974b) is based on young specimens of four different naticids, none of which is *rizzae* (SMF 239393/4 examined).



Figures 1822-1829. Genera *Tectonatica, Euspira, Amauropsis* and *Cryptonatica*. **1822**, *Tectonatica rizzae*, BALGIM st DW136, 8.1 mm. **1823**, *T. rizzae*, BIACORES st 89, 10.6 mm. **1824**, *T. filosa*, Calvi, Corsica, 30-70 m, 13 mm. **1825**, *Euspira talismani*, holotype, 11 mm. **1826**, *E. grossularia*, Abene, southern Senegal, 53 m, 14.5 mm. **1827**, *A. islandica*, Mossel Bay, Vestspetsbergen, 33 mm. **1828**, *Amauropsis islandica*, Chatanga Bay, Siberia, 10 m, 21 mm. **1829**, *Cryptonatica bathybii*, Norwegian Sea, 11.5 mm.

Genus *EUSPIRA* Agassiz, 1837

Euspira Agassiz, 1837:14. Type species, by subsequent designation (Bucquoy, Dautzenberg & Dollfus 1883:143), *Natica glaucinoides* J. Sowerby, 1812. Great Britain, Eocene.
Lunatia Gray, 1847b:149. Type species, by original designation, *Natica ampullaria* Lamarck, 1822. Described from unknown locality but assumed to be a synonym of *Natica heros* Say, 1822 (Philippi 1852:49), from northeastern America, or a synonym of *Euspira catena* (da Costa, 1778) from western Europe (Mermod 1953:183).

Remarks: Kuroda, Habe & Oyama (1971), Kilburn (1976), Marincovich (1977), and Majima (1989) used *Euspira* for various naticids for which previously had been used the generic name *Lunatia*. We agree that *Lunatia* is a subjective junior synonym of *Euspira*, which thus has to be used. This is strongly supported by Kabat (1991).

There has been five independant type designations of *Euspira*. Bucquoy, Dautzenberg & Dollfus (1883:143) and Newton (1915:233) designated *Natica glaucinoides* Sowerby, 1812; Cossmann (1888:178) designated "*Euspira canaliculata* Morris & Lycett", and finally Harris (1897:264) and Dall (1908:333) designated *Ampullaria sigaretina* Lamarck, 1804. The first of these designations is valid, since *N. glaucinoides* is one of the two species included in *Euspira* by Agassiz in the first part of the German edition of "British Mineral Conchology".

Natica glaucinoides was redescribed and figured by Wrigley (1949:14, figs 14, 15) and is very similar to the Recent species previously classified in *Lunatia*.

KEY TO THE SPECIES OF *EUSPIRA*

A. Shell light brown with spirally arranged, darker blotches, protoconch multispiral ..... *E. grossularia* (p. 768)
A. Shell white with traces of light brown periostracum, protoconch paucispiral ..... *E. talismani* (p. 767)

Euspira talismani sp.n. Figs 1797, 1825, 1898, 1909

Type material: Holotype in MNHN.

Type locality: TALISMAN 1883, dr 96, 20°41' N, 18°08' W, 1283 m.

Material examined: The holotype and --TALISMAN 1883 dr 96-98, 20°41' N, 18°08' W - 20°32' N, 18°20' W, 1283-1090 m, 4 shs; dr 87, 22°54' N, 17°26' W, 860 m (1013-1113 m on label), 2 shs; WALDA st CY05, 21°46S, 11°08' W, 2953 m, 3 shs.

Distribution: Only known from the material examined from off Mauritania and Namibia, in about 1000-3000 m.

Description: Shell (Fig. 1825) depressed and globular, solid with thin greenish periostracum. Protoconch paucispiral, corroded in all specimens; at least half a whorl missing in holotype; together with teleoconch 3.5 whorls remain. Suture deep and channelled with sharp edge of later whorl projecting above surface of preceding whorl. No sculpture except fine and regular incremental lines, more distinct at suture, about 1015 per mm at periphery of body-whorl. Inner lip distinctly and abruptly thickened from lower part of umbilicus, up to preceding whorl. Umbilicus (Fig. 1898)

deep and open, not covered by callus or reflected inner lip, with a furrow below the thickened part of the inner lip. Aperture semi-circular with straight but oblique inner lip.
Dimensions. Height of holotype 11.0 mm, diameter 11.0 mm, height of aperture 10.0 mm, breadth 5.0 mm. Another specimen from Mauritania is 14 mm high and one from Namibia 16 mm.
Radula (Fig. 1797). Outer marginal simple, claw-like. Inner marginal distinctly bifurcated. Lateral tooth usually lacking secondary denticles, only major cusp present. Central tooth with blunt main cusp and 1 or 2 indistinct lateral denticles.
Operculum (Fig. 1909). Corneous, thin, brownish with rapidly enlarging nucleus at 31% of height.
Etymology: talismani, named after Talisman, a French steamer used for explorations along the west African coast in 1883, under the direction of A. Milne-Edwards.

Remarks: Euspira talismani resembles *E. pallida* (Broderip & Sowerby, 1829) (Arctic, shallow water), but has a more depressed spire, the inner lip has an abrupt thickening at the level of the umbilicus and the whorls are flatter.

Euspira grossularia (Marche-Marchad, 1957)
Figs 1796, 1826, 1844, 1881, 1897, 1910

Natica catena var. *punctata* Monterosato, 1878:96 (*nom. nud.*) *fide* Schiró (1977:6).
Polinices grossularia Marche-Marchad, 1957:201, pl. 1 fig. 3.

Type material: Holotype in MNHN.

Type locality: South of Cape Verde Peninsula, 14°20' N, 17°24' W, 80 m.

Material examined: The holotype and --BALGIM st CP149, 35°47' N, 05°11' W, 354-390 m, 2 shs; Mauritania, 19°24' N, 16°52' W, 82 m, 2 spms; Mauritania, 19°24' N, 17°01' W, 98 m, 1 sh; Mauritania, 19°00' N, 16°45' W, 200 m, 2 shs; Mauritania, 17°18' N, 16°32' W, 104 m, 1 sh; Mauritania, 18°06' N, 16°25' W, 107 m, 1 sh; Mauritania, 17°42' N, 16°31' W, 151 m, 1 sh; -Mauritania, 17°12' N, 16°38' W, 140 m, 1 sh; Mauritania, 17°36' N, 16°17' W, 54 m, 1 spm; Mauritania, 17°30' N, 16°24' W, 88 m, 1 sh; Mauritania, 17°17' N, 16°28' W, 95 m, 1 spm; Mauritania, 17°17' N, 16°30' W, 85 m, 2 sh; Mauritania, 17°24' N, 16°33' W, 130 m, 1 sh; Mauritania, 17°24' N, 16°33' W, 168 m, 1 sh; Mauritania, 17°54' N, 16°32' W, 200 m, 2 shs; Mauritania, 19°42' N, 17°04' W, 126 m, 1 spm; Mauritania, 18°12' N, 16°32' W, 200 m, 1 spm; Mauritania, 18°06' N, 16°19' W, 45 m, 1 sh; Mauritania, 19°18' N, 16°49' W, 210 m, 1 spm; Mauritania, 19°00' N, 16°39' W, 84 m, 2 shs; Senegal, South of Cape Verde Peninsula, 14°22' N, 17°22' W, 130-132 m, 3 spms; Senegal, South of Cape Verde Peninsula, 198-80 m, 2 spms; Senegal, off Cape Verde Peninsula, 135 m, 2 shs; Senegal, south of Gorée, 95-98 m, 1 sh; Senegal, off Gorée, 170 m, 1 sh; Senegal, Abéné, 13°02' N, 17°26' W, 53 m, 1 spm; --Dahomey, off Ouidah, 06°10' N, 02°05' W, 200 m, 1 sh; Angola, Moçamedes, Praia Amelia, 40-60 m, 1 sh; Angola, Ilha de Luanda, 75-80 m, 7 spms; Angola, Ilha de Luanda, 40-60 m, 1 sh; Angola, off Mussulo, 90-100 m, 1 spm.

Distribution: From the Alboran Sea to Angola in about 30-400 m (Dixon & Ryall 1986). A record from Palermo, Sicily, 30 m (Monterosato 1878) seems doubtful, but was validated by Schiró (1977).

Remarks: Euspira grossularia is hardly a deep-sea species but since it occurs on the outer part of the shelf and is little known from coastal waters we have decided to include it.

The larval shell (Fig. 1844) consists of 2.0 whorls and has a diameter of 1.2 mm. It indicates planktotrophic development, probably combined with adelphophagy since the whorls are rapidly increasing in diameter, as in *Euspira catena* (Da Costa, 1778) which is known to have such development (Thorson 1946).

Genus *AMAUROPSIS* Mörch, 1857

Amauropsis Mörch, 1857:81. Type species, by monotypy, *Nerita islandica* Gmelin, 1791 (Figs 1798, 1827-1828). Arctic.
Choristes Carpenter [in Dawson], 1872:392. Type species, by monotypy, *C. elegans* Carpenter, 1872. Canada, glacial fossil. (***Syn. nov.***)

Remarks: In the absence of a better choice we have used the genus *Amauropsis* to include certain naticids characterized by having an umbilicus or umbilical fissure totally devoid of any kind of ridges and formed simply by the thin, simple inner lip (Fig. 1899, 1900). The operculum is corneous.

Golikov & Starobogatov (1975), Marincovich (1977) and Bouchet & Warén (1979a) considered *Choristes* to belong to the Naticidae, while previous authors had placed it in a separate family, Choristidae. This family was introduced by Verrill (1882) for a species he had identified with *C. elegans* Carpenter in Dawson, 1872 (Fig. 1953). His species, however, is not a naticid, but the genus *Choristella* Bush, 1897 is available for it and Bouchet & Warén consequently established the family name Choristellidae. *Choristella* is now considered to belong to the Archaeogastropoda (McLean in preparation). Kabat (1989) suggested that the ICZN should change the family name Choristidae to Choristeidae, in order to stabilize the better-known Choristidae (Insecta, Mecoptera).

Marincovich (1977) used *Choristes* for two East Pacific deep-water naticids with a characteristic radula, similar to that of *N. brassiculina* (Figs 1800, 1807), but still remain the problems with the identification and systematic position of *Choristes elegans*, the type species.

Choristes elegans was described from "*Saxicava* sand", Montreal, from where Dawson also listed: *Saxicava rugosa, Mya truncata, Mya arenaria, Macoma groenlandica, Lymnaea elodes, Planorbis bicarinatus, P. trivolvis, P. parvus, Buccinum undatum, B. totteni*, undoubtedly an arctic fauna with fresh-water outflow. *Choristes elegans* has later been mentioned in the North American literature on postglacial deposits, but without additional information.

McLean (pers. comm.) has suggested to us that *Choristes elegans* may be a brackish water form of *Amauropsis islandica* and search in USNM and SMNH for similar specimens revealed the specimen figured in Fig. 1828, taken by the VEGA Expedition in 1878, close to the mouth of the Chatanga river, northern Siberia. Derjugin (1932) described the mollusc fauna of this part of the Laptev sea and it is characterized by the outflow of fresh water from the Lena and Chatanga rivers. The figured specimen resembles *C. elegans* (Fig. 1953) in all aspects except in not having an umbilicus, and we agree with McLean that Carpenter's species simply is a brackish water form of *A. islandica* (Fig. 1827).

The genus *Amauropsis* is one of the oldest groups of the Naticidae and it is represented by several species hardly distinguishable from modern ones, already in the Cassian deposits in northern Italy (Triassic, Zardini 1978).

Barnard (1963) used *Falsilunatia* Powell, 1951 for species with a radula similar to that of *A. brassiculina*, but its type species, *Natica soluta* Gould, 1848 (radula see Dell 1990:fig. 271) has an umbilicus similar to *Euspira pallida*, with a thickened, solid inner lip at the level of the umbilicus. It is, however, possible that the shape of the central radular tooth is a synapomorphy, and that *Falsilunatia* should be used for *brassiculina*. Furthermore, certain species, for which Dell (1990) used the generic name *Bulbus* have this type of semicircular central tooth. Our impression is that they do not come close to *Bulbus*, as exemplified by the type species, *B. smithi* Brown, 1839, but possibly represent a lineage of naticids, together with *Falsilunatia, A. brassiculina* and *Choristes* (*sensu* Marincovich 1977).

KEY TO THE DEEP-WATER SPECIES OF *AMAUROPSIS*

A. Central radular tooth semi-circular, spire low ..... *A. brassiculina* (p. 770)
A. Central radular tooth square, spire tall ..... *A. sphaeroides* (p. 772)

Amauropsis brassiculina (Locard, 1897)
Figs 1800, 1807, 1830-1832, 1899, 1911

Natica bullula Locard, 1897:478, pl. 20 figs 11-14.
Natica olivella Locard, 1897:479, pl. 20 figs 15-18.
Natica olivella var. *major* Locard, 1897:480.
Natica brassiculina Locard, 1897:480, pl. 20 figs 19-22.
Natica brachya Locard, 1897:480 (introduced as a synonym of *N. brassiculina*).

Type materials: N. bullula, lectotype and one paralectotype, here selected (Fig. 1831), in MNHN; *N. brassiculina*, lectotype, here selected (Fig. 1830), in MNHN; *N. olivella*, lectotype, here selected (Fig. 1832), in MNHN.

Type localities: N. bullula, TALISMAN 1883 dr 100, 19°12' N, 17°57' W, 2324 m; *N. brassiculina*, TALISMAN 1883 dr 86, 22°55' N, 17°29' W, 930 m, off West Africa; *N. olivella*, TRAVAILLEUR 1882 dr 1, 44°17' N, 05°32' W, 564 m.

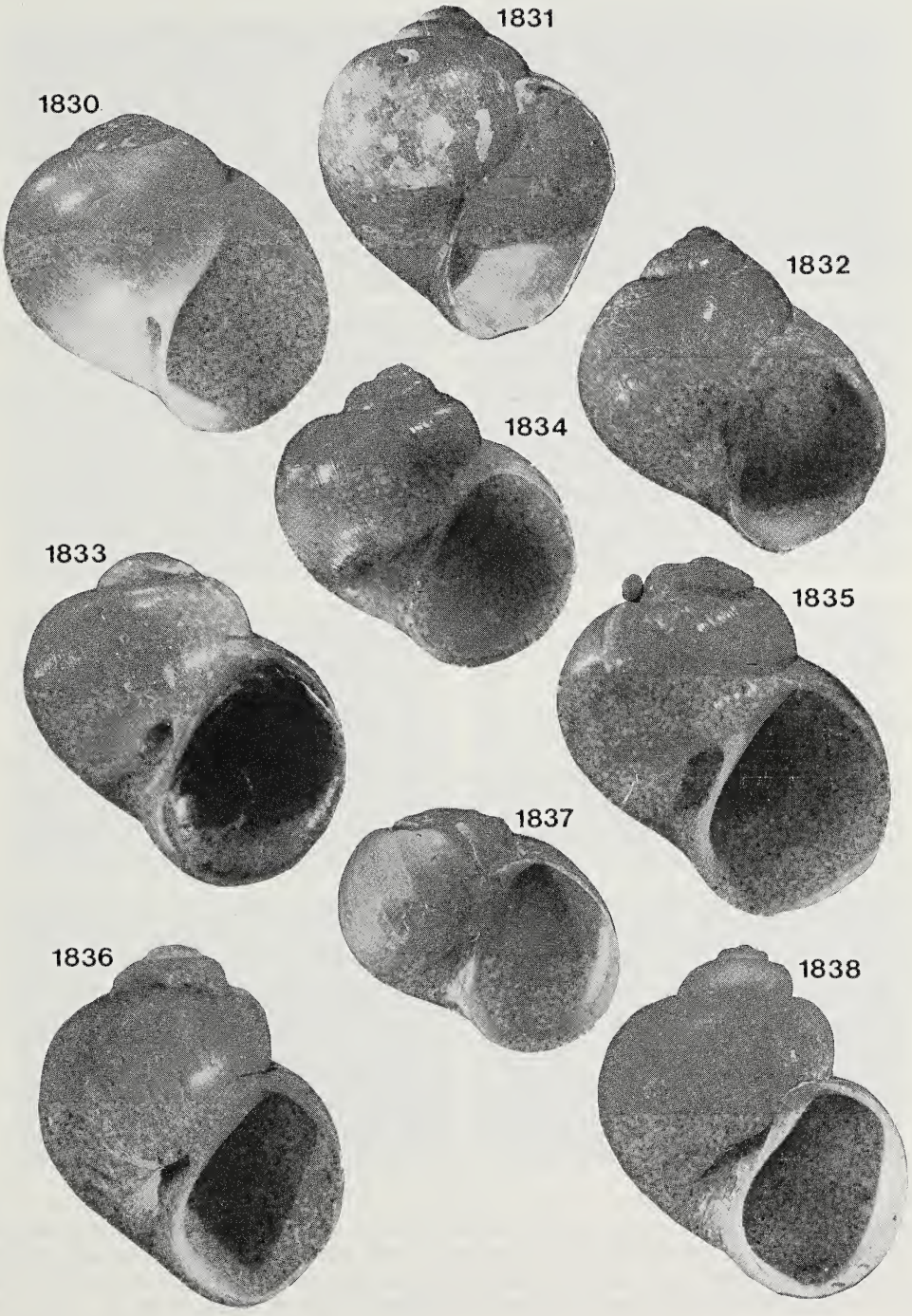
Material examined: The types and BALGIM st CP18, 36°48' N, 09°21' W, 1544-1612 m, 1 sh (with *Leptonotis perplexus* inside); --TALISMAN 1883 dr 36, 31°34' N, 10°21' W, 912-1050 m, 2 shs; dr 84-86, 22°55' N, 17°29' W, 860 m, 9 spms; WALDA st CY05, 21°46' N, 11°08' W, 2953 m, 1 sh; DISCOVERY st 7991, 24°12' N, 17°06' W, 1510 m, 1 sh; st 8977, 31°26' N, 10°47' W, 974-1032 m, 2 shs.

Distribution: The distribution is uncertain because the information on the labels from the TRAVAILLEUR and TALISMAN Expeditions is inconsistent and probably erroneous. We can only confirm a range from the Ibero-Moroccan Gulf to off southernmost Morocco, in 1000-3000 m.

Remarks: As first revisors, we prefer the name *Natica brassiculina* instead of *N. bullula* since *N. brassiculina* was based on a live taken specimen (Fig. 1830) while *N. bullula* was based on two empty (but larger: 22.5 mm) shells (Fig. 1831) in rather poor condition.

The labelling of the TRAVAILLEUR and TALISMAN samples is unsatisfactory. Locard listed *N. bullula* from TALISMAN st 97 and gave a depth of 2324 m (the type is marked st 97, but actual depth is 1090 m). One of these numbers is wrong, but we believe the depth to be correct and have therefore changed the station number to 100, the depth of which was 2324 m. The type of *N. brassiculina* is also recorded from unexpectedly shallow water, 500-700 m, but we suppose that it originates from a locality close to that of *N. bullula*.

Figures 1830-1838. Genus *Amauropsis*. **1830**, *A. brassiculina*, lectotype, 13.8 mm. **1831**, *A. brassiculina*, lectotype of *N. bullula*, 23.4 mm. **1832**, *A. brassiculina*, lectotype of *N. olivella*, 19.5 mm. **1833**, *A. sphaeroides*, INCAL st CP08, 4.4 mm. **1834**, *A. sphaeroides*, SARSIA st 7614, 6.3 mm. **1835**, *A. sphaeroides*, INCAL st CP04, 7.4 mm. **1836**, *A. sphaeroides*, INCAL st CP06, 15 mm. **1837**, *A. sphaeroides*, INCAL st CP13, 15 mm. **1838**, *A. sphaeroides*, DISCOVERY st 10106#1, 19.3 mm.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1838

The only existing type specimen of *Natica olivella* has no indication about origin, except that it was taken by the TRAVAILLEUR Exp, in the Bay of Biscay. Locard's list of *N. olivella* contains a single record from that expedition and locality, viz. "dr 1", data see above. This is here considered the type locality for *olivella*, but must be considered uncertain.

Amauropsis brassiculina has a very characteristic central tooth of the radula (Figs 1800, 1807), of a half-circular shape with a single, blunt, peg-like cusp. Such a central tooth is known from several Antarctic, South African and South American species (see e.g. Powell 1951, Barnard 1963) and from *Amauropsis carpenteri* (Dall, 1896) (Marincovich 1977:text fig. 11b), from western Central America. The shell shape of *A. carpenteri* is, however, much more similar and virtually indistinguishable from *A. sphaeroides*, which has a normal naticid radula (Fig. 1799).

Falsilunatia pseudopsila Barnard, 1963 from off South Africa, has a radula similar to *Amauropsis brassiculina* and its parietal wall shows a similar curvature. Therefore we think it should also be placed in *Amauropsis* together with *A. brassiculina*. It differs from *A. brassiculina* in having the umbilicus almost closed, but there is no callus, only a reflected inner lip.

We have not found any specimen with a well preserved protoconch.

Amauropsis brassiculina resembles *Euspira pallida*, but that species has a straighter parietal wall and a broad, low internal ridge in the umbilicus. It differs also in radular characters.

Amauropsis sphaeroides (Figs 1833-8) differs from *A. brassiculina* in having a straight parietal wall and a more solid shell, with more convex whorls and taller spire. The radula is also different (Fig. 1799), with a typical naticid central tooth.

Young specimens may resemble *Polinices subplicata* (Figs 1865-70), but that species has a low and diffuse tubercle on the parietal wall, just where the inner lip leaves its contact with the preceding whorl.

Amauropsis sphaeroides (Jeffreys, 1877)
Figs 1799, 1833-1838, 1860, 1882, 1900, 1912

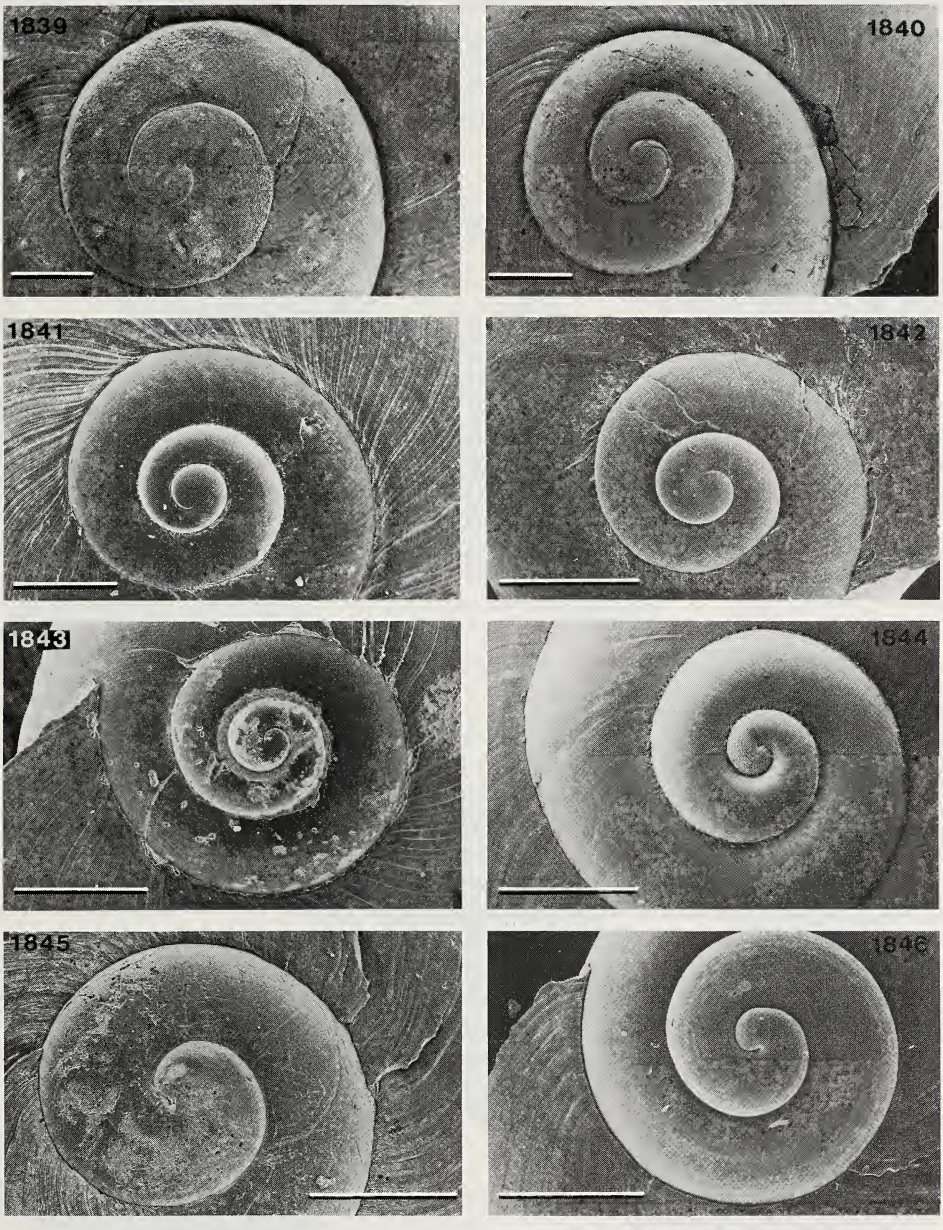
Natica sphaeroides Jeffreys, 1877:319.

Type material: Holotype USNM 188244 (Warén 1980:pl.5 figs 13-14).

Type locality: VALOROUS Exp st 9, off southwestern Greenland, 59°10' N, 50°25' W, 3185 m.

Material examined: The holotype and NORATLANTE st B5, 55°43' N, 49°24' W, 3676 m, 1 spm; NORATLANTE st B4, 52°05' N, 45°34' W, 4166-4452 m, 2 spms; DISCOVERY st 10106#1, 50°41' N, 12°50' W, 2300-2315 m, 1 sh;--st 10112#1, 50°26' N, 13°18' W, 2640-2660 m, 1 sh; st 50613#1, 50°29' N, 13°02' W, 2440 m, 1 sh; st 50605#1, 50°11' N, 13°32' W, 2820-2930 m, 1 sh; st 10112#2, 50°25' N, 13°20' W, 2640-2650 m, 2 spms; INCAL st CP09, 50°15' N, 13°16' W, 2659 m, 1 sh; st DS09, 55°08' N, 12°52' W, 2897 m, 1 sh; st WS01, 50°19' N, 13°08' W, 2550 m, 1 spm; st OS07, 47°31' N, 09°34' W, 4249 m, 1 spm; st DS14, 47°33' N, 09°36' W, 4254 m, 1 spm; st WS07, 47°31' N, 09°37' W, 4281 m, 4 shs (SMNH); st WS08, 47°30' N, 09°34' W, 4287 m, 2 sh; st CP06, 55°02' N, 12°40' W, 2288-2893 m, 1 sh; st WS09, 47°29' N, 09°34' W, 4277 m, 6 spms; st OS06, 46°27' N, 09°36' W, 4316 m, 1 spm; st OS04, 46°04' N, 10°13' W, 4796 m, 1 spm; st DS13, 46°02' N, 10°18' W, 4822 m, 1 sh; st CP08, 50°15' N, 13°13' W, 2644 m, 1 spm; st WS10, 47°27' N, 09°40' W, 4354 m, 3 spms; --BIOGAS st CP13, 47°34' N, 09°38' W, 4134 m, 3 shs; st CP07, 44°10' N, 04°16' W, 2170 m, 1 sh; st DS52, 44°06' N, 04°22' W, 2006 m, 2 spms; st DS55, 47°35' N, 09°41' W, 4125 m, 1 spm; st CV41, 47°27' N, 09°01' W, 3800 m, 1 spm; st CV30, 46°33' N, 10°20' W, 4518 m, 1 spm; MONACO Exp st 2986, 45°07.5' N, 07°06' W, 4870 m, 1 sh; SARSIA st 7614, 43°43' N, 03°38' W, 1100 m, 1 spm; DISCOVERY st 9540, 20°56' N, 18°09' W, 2005 m, 11 spms (SMNH); --st 9134, 21°55' N, 18°02' W, 1945 m, 5 spms; TALISMAN 1883, dr 84-86, ca 22°55' N, 17°29' W, 830 m, 1 sh.

Distribution: From off southeastern Greenland to off Mauritania in about 1000-5000 m.



Figures 1839-1846. Protoconchs of naticids. **1839**, *Cryptonatica operculata*, BALGIM st DR37. **1840,** *C. affinis*, THALASSA st Z409. **1841,** *Tectonatica rizzae*, BALGIM st DW136. **1842,** *T. rizzae*, Ponta Delgada, Azores. **1843,** *T. filosa*, Ceuta, Strait of Gibraltar. **1844,** *Euspira grossularia*, Mauretania, 17°54' N, 16°32' W, 200 m. **1845,** *Cryptonatica operculata*, BALGIM st DR37. **1846,** *C. affinis*, off Korsfjorden, Norway.

All scale lines 0.5 mm.

Remarks: Jeffreys named this species conditionally, but since this was done before 1960, his name has to stand. The name was based on a fragmentary juvenile, 2.5 mm diameter and consisting of 1.5 whorls.

The identification of *N. sphaeroides* is, however, quite certain, since there is no other naticid known to us from the North Atlantic that reaches this size at 1.5 whorls. *Natica subplicata* has a diameter of 1.8 mm (at 1.5 whorls) and *Euspira pallida* has a diameter of the shell of 2.0 mm (at 1.5 whorls), but in the latter case, the initial whorl is very flat, not convex as in *sphaeroides*.

For differences from *A. brassiculina*, see under that species.

Genus *POLINICES* Montfort, 1810

Polinices Montfort, 1810:223-224. Type species, by original designation, *P. albus* Montfort, 1810. Indo-Pacific.

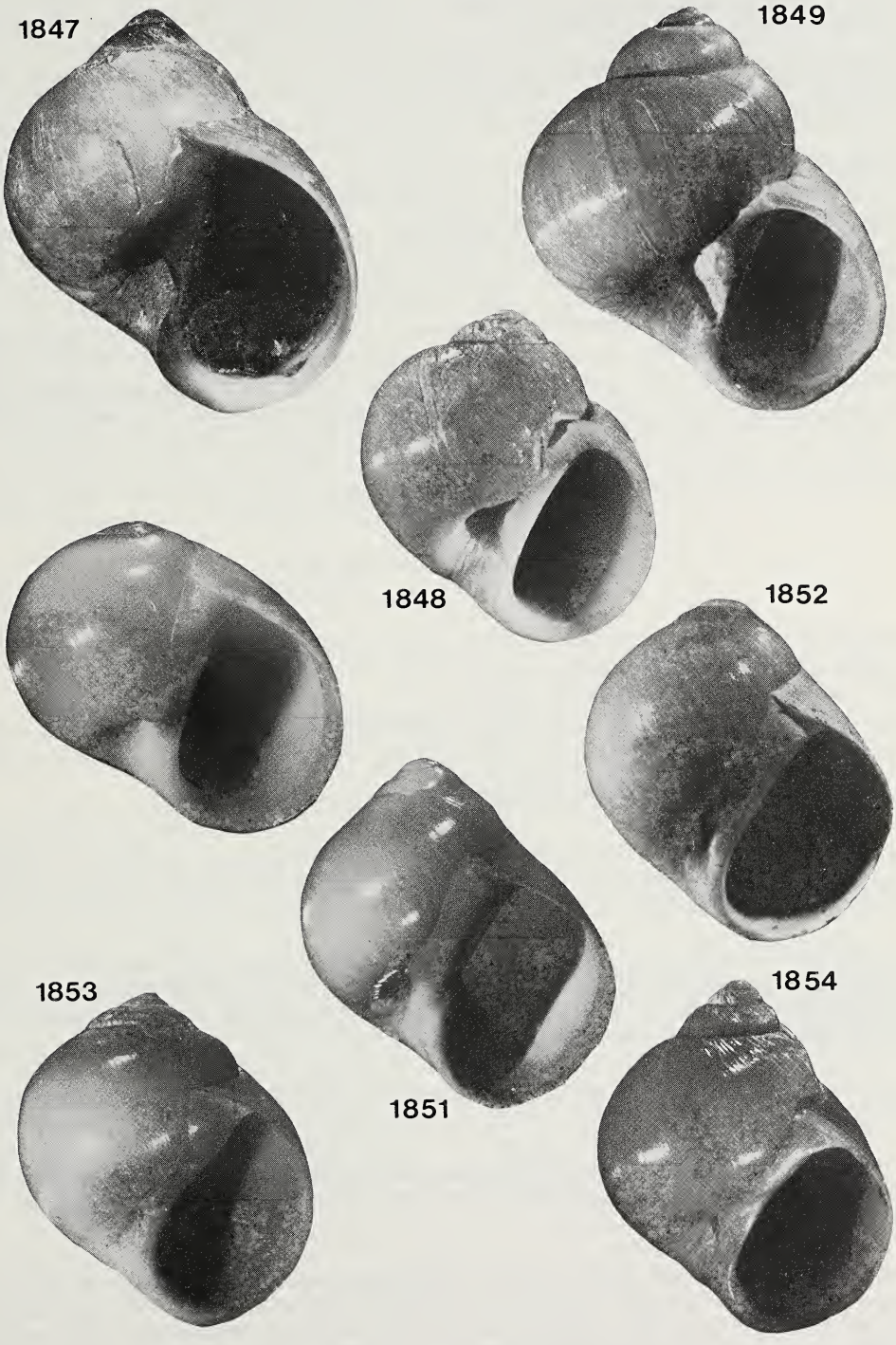
Remarks: There have been some problems with the type species of *Polinices*. The earliest designations of type species, are those by Gray (1847b, Nov.) and Herrmannsen (1847, Dec.), who both used *Nerita mammilla* Linnaeus, 1758 as type species, a species whose identity was elucidated by Kabat (1990b). Marincovich (1977) considered that Montfort himself designated *P. albus* Montfort as type species (indicated by Montfort's use of the word "type"). Kabat's action of designating the lectotype of *N. mammilla* as neotype of *P. albus* elegantly makes any controversy about these designations superfluous.

We have provisionally used the genus *Polinices* for a number of European species with corneous operculum, fairly tall spire, ovate shape and with strong furrows in the umbilicus. We admit that they differ considerably from the typical, tropical shallow water species of *Polinices*, but we prefer to use this well known genus until the family as a whole is better known.

In addition to the species discussed here, Locard (1896:483) recorded "*Natica apora* Watson" from TRAVAILLEUR 1881, dr 40, north of Spain, 392 m (Fig. 1871). The specimen is probably not conspecific with Watson's species, which was described from about 1500 m depth between Australia and New Guinea (1886:454). We have seen no additional European specimens of Locard's species, but there is a badly broken shell taken in a depth of 725 m off southern Morocco, by DISCOVERY, which may be conspecific. This may mean that Locard had mislabelled his specimen, which is not rare, and we leave the case until more material is known.

Polinices pulchella (Risso, 1826) (=*Natica poliana* delle Chiaje, 1827 = *Natica alderi* Forbes, 1838) is occasionally found down to a few hundred meters depth, but is not included in our treatment, except in the key. We have compared Risso's types in MNHN (see Arnaud 1978) with a rich material of Mediterranean and Atlantic specimens, and can find no distinct difference. *Nerita nitida* Donovan, 1804 was based on a West Indian shell (Jeffreys 1867:226).

Figures 1847-1854. Genus *Polinices*. **1847,** *Polinices fusca*, POLYMEDE st CM08, 35°17' N, 04°40' W, 281 m, 27 mm. **1848,** *P. montagui*, off Morocco, 199 m, 6 mm. **1849,** *P. montagui*, THALASSA st W368, 13.5 mm. **1850,** *P. obtusa*, INCAL st CP06, 10.2 mm. **1851,** *P. obtusa*, BIOGAS st CP11, 13.9 mm. **1852,** *P. obtusa*, THALASSA st W388, 8.6 mm. **1853,** *P. phaeocephala*, BIACORES st 191, 14.4 mm. **1854,** *P. subplicata*, lectotype of *Natica extenta*, 9.5 mm.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1854

KEY TO THE SPECIES OF *POLINICES*

A. Larval shell with about 2.5 whorls, brownish ..... B
A. Larval shell with less than 2.0 whorls ..... D

B. Suture channelled for some distance, shell uniformly coloured ..... *P. montagui* (p. 779)
B. Suture not channelled C

C. Shell mottled with violet ..... *P. pulchella* (see above)
C. Shell brownish ..... *P. fusca* (p. 776)

D. Larval shell indistinctly set off; initial whorl very small and flat ..... *P. obtusa* (p. 777)
D. Larval shell with convex whorls ..... E

E. Larval shell of less than 1.0 whorl ..... F
E. Larval shell of 1.5 whorls ..... *P. presubplicata* (p. 788)

F. From the Azores ..... *P. phaeocephala* (p. 788)
F. From eastern Atlantic ..... *P. subplicata* (p. 783)

Polinices fusca (de Blainville, 1825)
Figs 1801, 1847, 1861, 1885, 1901, 1913

Nerita laevida Laskey, 1811:409.
Natica fusca de Blainville, 1825:249.
"Natice marron" de Blainville 1830:pl. 14 fig. 3.
Natica sordida: Philippi 1844a:139, pl. 24 fig. 15 (not Swainson 1821).
Natica brocchiana Philippi, 1852:50, pl. 8 fig. 2.
Natica angulata Jeffreys, 1885:32, pl. 4 fig. 3.
Natica compacta Jeffreys, 1885:33, pl. 4 figs 5, 5a.

Type materials: N. laevida, not known; *N. fusca*, neotype, here designated, in MNHN ; *N. angulata*, syntypes BMNH 1885.11.5. 2338-39, 2345, 2371; *N. compacta*, syntypes BMNH 1885.11.5.2467-72, 2345, 2371.

Type localities: N. laevida, near Dunbar, Scotland; *N. fusca*, off Dugi Otoki, Yugoslavia, 200-210 m; *N. angulata*, not designated, PORCUPINE Exp 1869 st 4, 51°56' N, 13°39' W, 457-981 m, and PORCUPINE Exp 1870 st 56, 37°03' N, 11°36' E, 710 m; *N. compacta*, not designated, PORCUPINE Exp 1869 st 23, 23a, 30, and 1870, st 16, 17, 17a.

Material examined: The types mentioned and 180 samples with 550 specimens from all parts of the distributional area.

Distribution: From off Scotland and the Hebrides south to Angola (Dixon & Ryall 1986), including the whole Mediterranean, usually in 100-1000 m. Not known from the Faroes, Scandinavia or Iceland.

Remarks: Around the middle of the 19th century, this species was known as *Natica sordida*, a name credited to Swainson (Philippi 1844a:139) or Philippi (Forbes & Hanley 1851:334, Jeffreys 1867:218). Philippi's use of the name was based on an erroneous identification, which he later (1852:50) recognized. Employment of the name "*fusca* de Blainville" was first suggested by Récluz (1852:271), and became established by Weinkauff (1867:251) and Monterosato (1875:36).

Jeffreys (1867:220) remarked that *Nerita laevida* may be an older name, but no other authors seem to have commented on Laskey's name. We do not know to what extent Jeffreys' doubt of the identity of *laevida* were caused by unwillingness to change the name he used *(Natica sordida)*. Laskey's comment "It bears some resemblance to *N. glaucina* [=*Euspira catena*] but has a more produced apex, and is divested of the markings of that shell" and his correct ennumeration of the other British naticids makes it obvious that the name was intended for the present species. We have nevertheless not used it and intend to apply to the ICZN to get the name *laevida* suppressed and to conserve the much more well known name *fusca*.

In order to stabilize the name we have designated a neotype of *Natica fusca*. The shell consists of between six and seven whorls, but the different parts, protoconch and teleoconch can not be distinguished because of the normal corrosion. The shape is similar to Fig. 1847, but the whorls are slightly more convex and the spire slightly more depressed, as seems to be the normal form in the Adriatic and was illustrated by de Blainville. The upper part of the whorls is tightly appressed to the preceding whorl and forms a a continuation of these on the apical whorls, a low, demarcated slope on the last part of the body whorl. The suture is not channelled. The umbilicus is slightly broader than in Fig. 1901, but of the same morphology. The colour is brownish beige, darker along the suture, lighter on the base. Height 25 mm, diameter 23 mm, height of the aperture 20 mm, breadth 11 mm. The neotype was collected by F. Levi Setti, Milano.

The type of *N. compacta* is a juvenile naticid with multispiral protoconch, probably *P. fusca*. The larval shells of *P. fusca* and *montagui* are very similar, but that of *fusca* is slightly larger, about 1.6 mm instead of 1.2 mm diameter. Nothing is known about the biology of this species except that the larval development can be inferred to be planktotrophic.

Polinices obtusa (Jeffreys, 1885)
Figs 1803-1804, 1850-1852, 1855-1857, 1862, 1886, 1915

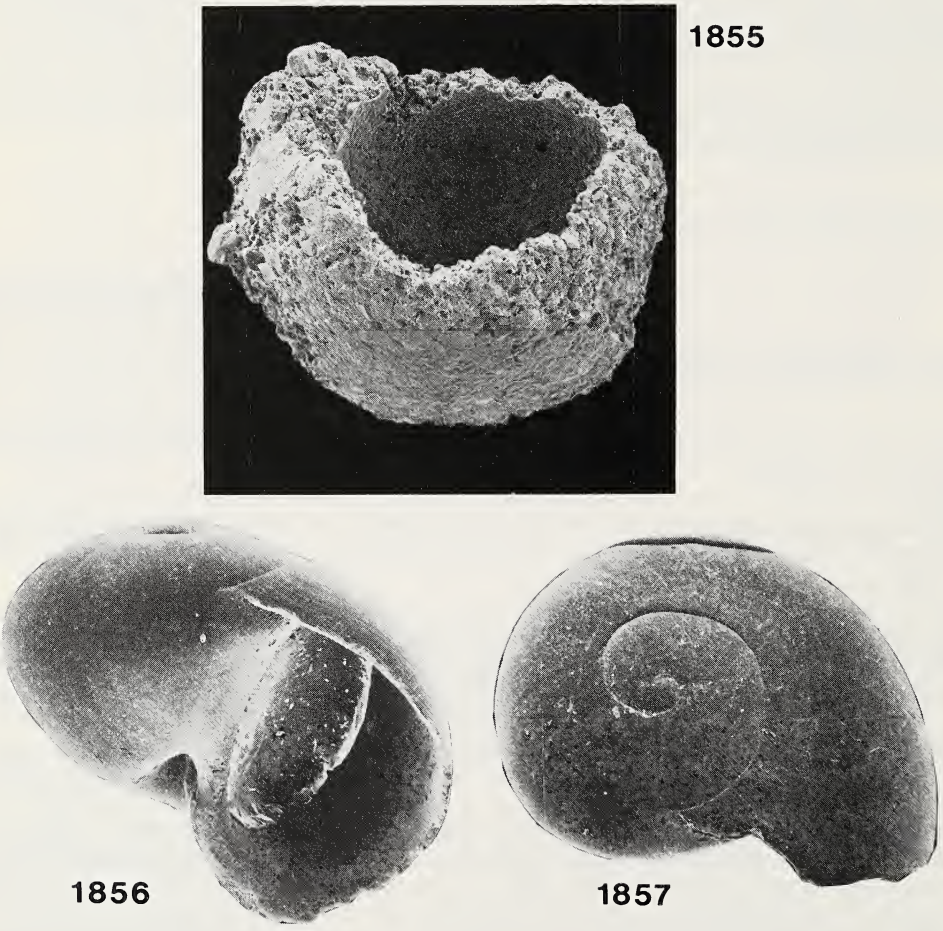
Natica obtusa Jeffreys, 1885:33, pl. 4 figs 6-6a.
Neverita pilula Locard, 1897:484, pl. 20 figs 27-30.

Type material: Natica obtusa, 2 syntypes, BMNH 1885.11.5.2340-2341; *N. pilula*, lectotype, here designated, in MNHN.

Type locality: Natica obtusa, PORCUPINE Exp st 16, 39°55' N, 09°56' W, 1809 m and st 17, 39°42' N, 09°43' W, 1092-1993 m, off Portugal; *N. pilula*, TRAVAILLEUR 1881, dr 1, 43°01' N, 09°38' W, 2018 m.

Material examined: The types and INGOLF st 10, 64°24' N, 28°50' W, 1484 m, 1 sh; CHALLENGER II st 2, 55°04' N, 12°05' W, 2857 m, 34 spms (RSM, SMNH); st 4, 56°52' N, 10°01' W, 1993 m, 63 spms, most young; st 6, 55°03' N, 12°29' W, 2900 m, 15 spms, mostly young; st 10, 56°37' N, 11°04' W, 2540 m, 2 spms; st 27, 54°40' N, 12°16' W, 2880 m, 12 spms; st 28, 54°33' N, 12°21' W, 2880 m, 3 spms; st 66, 56°39' N, 09°23' W, 1200 m, egg capsule; st 121, 54°37' N, 12°09' W, 2910 m, 1 spm; st 137, 54°34' N, 12°19' W, 2900 m, 3 spms; st 141, 54°44' N, 12°19' W, 2909 m, 5 shs; st 151, 57°21' N, 10°22' W, 2175 m, 2 shs; st 153, 57°20' N, 10°27' W, 2200 m, 1 spm; st 155, 48°27' N, 10°20' W, 1330 m, 1 spm; st 167, 54°05' N, 10°25' W, 2300 m, 2 shs; st 177, 57°18' N, 10°16' W, 2200 m, 4 spms; NORATLANTE st E1, 53°54' N, 17°53' W, 2456-2420 m, 1 sh; st B19, 47°29' N, 08°23' W, 2149-2047 m, 2 spms; st E6, 58°48' N, 52°57' W, 3610-3532 m, 1 spm; --DISCOVERY st 50304, 56°12' N, 12°00' W, 2600 m, 11 spms (SMNH); -- st 9754#3, 51°08' N, 12°01' W, 1484 m, 40 spms; st 10112#3, 50°19' N, 13°26' W, 2740-2755 m, 2 spms; st 10112#2, 50°25' N, 13°20' W, 2640-2650 m, 16 spms; st 10112#1, 50°26' N, 13°18' W, 2640-2660 m, 11 spms; st 50605#1, 50°11' N, 13°32' W, 2820-2930 m, 1 sh; st 9540, 20°56' N, 18°09' W, 2005 m, 1 sh; st 51417, 50°10' N, 13°22' W, 2770-2790 m, 7 spms; st 9779, 49°22' N, 12°49' W, 1398-1404 m, 2 spms; st 9753#7, 50°55' N, 12°11' W, 1942 m, 2 spms; --BIOGAS st DS87, 44°05' N, 04°19' W, 1913 m, 1 sh; INCAL st DS01, 57°59' N, 10°40' W, 2091 m,

13 spms; st DS02, 57°59' N, 10°49' W, 2081 m, 16 spms; st CP02, 57°58' N, 10°43' W, 2091 m, 4 spms; st CP05, 55°00' N, 12°30' W, 2884 m, 2 spms; st CP06, 55°02' N, 12°41' W, 2888-2893 m, 4 spms; st CP08, 50°15' N, 13°14' W, 2644 m, 5 spms; st CP09, 50°15' N, 13°16' W, 2659-2691 m, 3 spms; st DS08, 55°02' N, 12°34' W, 2891-2884 m, 1 spm; st DS09, 55°08' N, 12°53' W, 2081-2091 m, 11 spms; st DS10, 50°13' N, 13°16' W, 2719 m, 2 spms; st WS01, 50°19' N, 13°08' W, 2550-2539 m, 17 spms; st WS02, 50°20' N, 12°56' W, 2498-2505 m, 1 spm; st CP16, 47°30' N, 09°37' W, 4262-4240 m, 7 spms; BIOGAS st DS86, 44°05' N, 04°19' W, 1950 m, 4 spms; st DS52, 44°06' N, 04°22' W, 2006 m, 2 spms; st DS88, 44°05' N, 04°16' W, 1894 m, 1 spm; st CP37, 47°34' N, 08°40' W, 2175 m, 2 spms; st CP11, 47°36' N, 08°34' W, 2205 m, 3 shs; st CP10, 47°36'N, 08°34' W, 2205 m, 1 sh; st CP07, 44°10' N, 04°16' W, 2170 m, 3 spms; st DS57, 47°31' N, 09°06' W, 2906 m, 2 spms; st CP01, 47°35' N, 08°39' W, 2245



Figures 1855-1857. Egg-capsule and larvae of *Polinices obtusa*. **1855**, egg-capsule, CHALLENGER 2 st 66, diameter 3.1 mm. **1856**, front view of larva from egg-capsule, BIOGAS st DS86, 1.9 mm. **1857**, apical view of early benthic stage, BIOGAS st DS86, 2.6 mm.

m, 2 shs; st DS64, 47°29' N, 08°31' W, 2156 m, 1 sh; st CV23, 47°33' N, 08°34' W, 2034 m, 1 spm; st DS51, 44°11' N, 04°15' W, 2430 m, 1 spm; THALASSA st W388, 44°05' N, 04°28' W, 750-850 m, 9 spms; st X334, 44°10' N, 04°52' W, 1940-1870 m, 1 spm; st X339, 44°10' N, 04°31' W, 1600-1520 m, 1 spm; st Y373, 41°35' N, 09°19' W, 1200 m, 3 shs (fossil, high form); st Y401, 40°37' N, 09°22' W, 1040 m, 3 shs (fossil, high form); st Z409, 47°43' N, 08°02' W, 1035-1080 m, 1 sh (fossil, high form); Bay of Biscay, 1 spm, det. *nana* (coll. Locard, MNHN); Bay of Biscay, 1 spm, det. *nana* (coll. Locard, MNHN); SARSIA st 7601, 43°52' N, 03°43' W, 3100-3080 m, 1 sh (fossil, high form); st 7627, 43°47' N, 03°46' W, 1925-1990 m, 1 sh; st 7614, 43°43' N, 03°38' W, 1100 m, 1 sh; PORCUPINE Exp 1870 st 17, 39°42' N, 09°43' W, 1092-1993 m, 7 shs (BMNH); st 3a, ca 48°30' N, 10°03' W, 910 m, 1 sh (USNM 188215); TRAVAILLLEUR 1882 dr 70, 43°59' N, 05°54' W, 1000 m, 3 shs; TALISMAN 1883, Praya, Cap Vert Is, 1 sh (det. *flammulata*); (dr 44?, 53?), 28°37' N, 13°02' W, 865 m, 1 sh; dr 84-86, ca 22°55' N, 17°26' W, 820-860 m, 10 shs; (dr 96?, 99?), 19°16' N, 18°00' W, 2330 m, 1 sh; -- SEAMOUNT 1 st DE48, 36°48' N, 14°32' W, 1350-1360 m, 1 sh; CANCAP st 2.067, 27°58' N, 14°12' W, 1820 m, 1 sh; st 2.058, 27°58' N, 13°15' W, 500 m, 1 sh; DISCOVERY st 9134, 21°55' N, 18°02' W, 1945 m, 4 spms.

Distribution: From the southern side of the Shetland-Faroe Ridge, along the European west coast, to West Africa, usually in 1000-3000 m. Not in the Mediterranean.

Remarks: Polinices obtusa can be recognized by the very flat apex (Fig. 1857) with a very small, but rapidly enlarging initial whorl. The shape of the shell is very variable (Figs 1850-2), some specimens being high-spired, some quite depressed. Also the shape of the umbilicus varies, but we have seen no correlation in these variables indicating that more than one species is involved.

Polinices obtusa differs from all known naticids (except southern populations of *Cryptonatica affinis*) in depositing the eggs in small egg capsules made of sand grains with one flat and one strongly convex side (Fig. 1855). One crawling young (Figs 1856-7) hatches from each capsule at a size of about 1.9 mm, but we do not know if it gets its nourishment from nurse eggs or yolk deposits.

Polinices montagui (Forbes, 1838)
Figs 1802, 1848-1849, 1858-1859, 1883, 1902, 1914

Nerita rufa: Montagu 1808:150, pl. 30 fig. 3 (not Born, 1778).
Natica montagui Forbes, 1838:32, pl. 2 figs 3-4.
Natica squalida MacGillivray, 1843:52, 128.
Natica rutila Macgillivray, 1843:51, 126.
Natica montacuti Jeffreys, 1867:227 (unjustified emendation).
Natica montacuti vars *albula, conica* Jeffreys, 1867:228.
Natica montagui vars *minor, elongata, ventricosa, albida* Locard, 1897:473 (*nom. nuda*).

Type materials: N. montagui, 1 possible syntype, SMNH 3953; *N. squalida* and *rutila*, not known; *N. montacuti* vars *albula* & *conica*, syntypes USNM 188444 and 202230 respectively.

Type localities: N. montagui "deep water on the north coast" [off Isle of Man?, British Isles]; *N. squalida*, deep water off Aberdeen, Scotland; *N. rutila*, Fraserburgh, Scotland; *N. montacuti* vars *albula* & *conica*, Shetland.

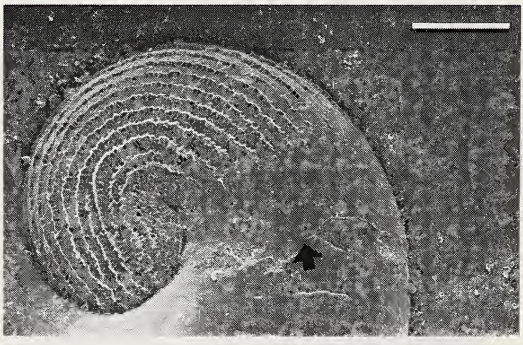
Material examined: The type mentioned and several thousand specimens from all parts of the distributional area.

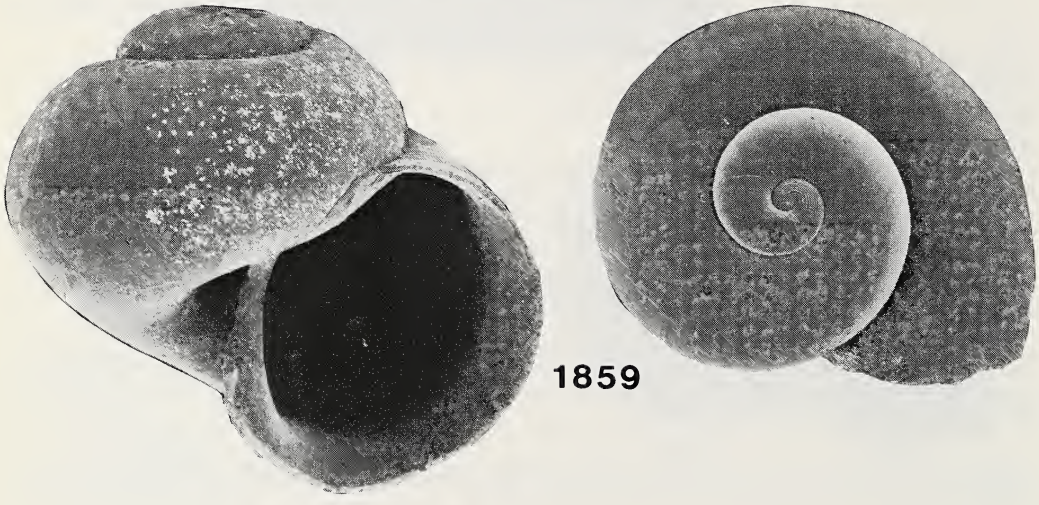
Distribution: Southern and western Iceland, northern Norway and southwards along the European coast, south to northwestern Morocco. Not in the Mediterranean (except as fossil). Normal depth range 10-500 m.

Remarks: Polinices montagui has its main distribution between 10 and 200 m, but regularly occurs in deeper water.

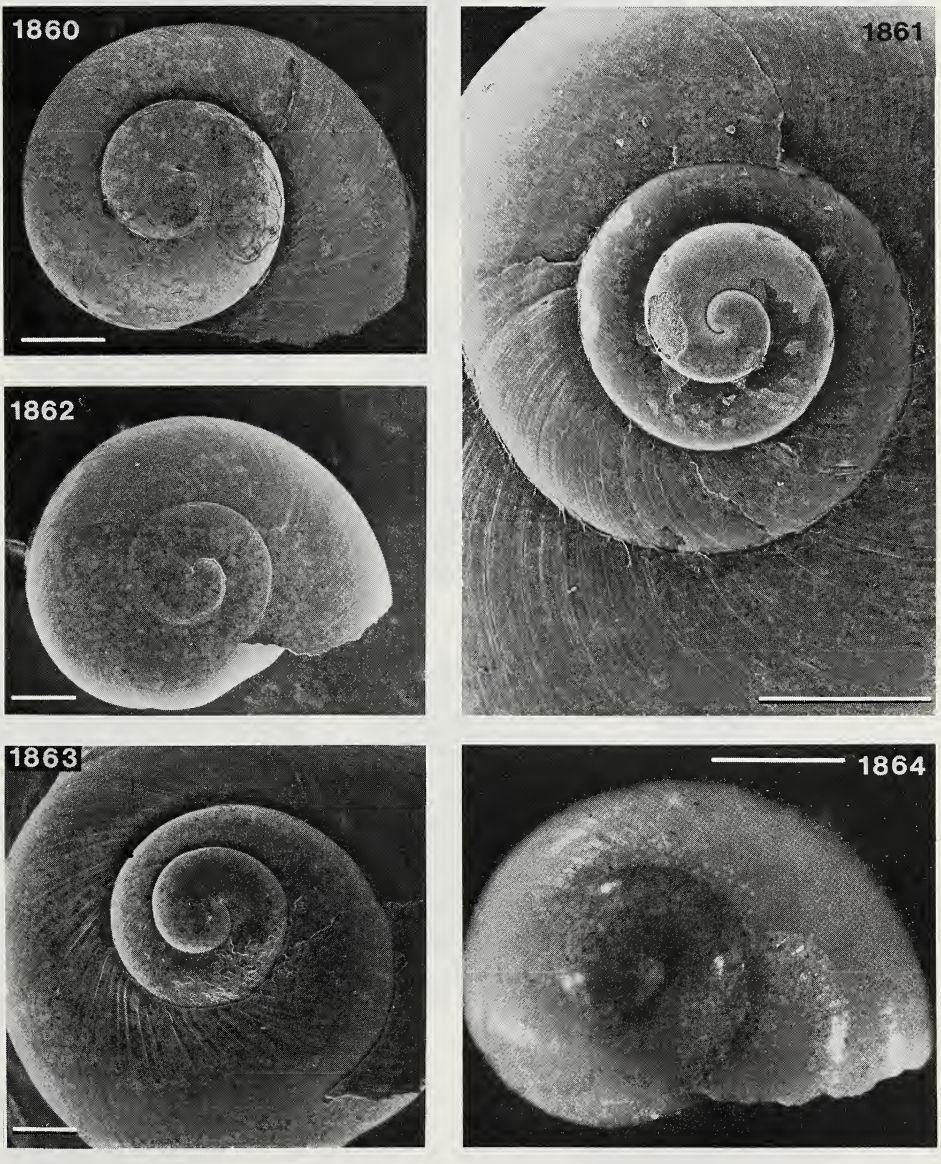
Juvenile specimens (Fig. 1883) may be confused with *P. fusca* (Fig. 1885), but that species has a larger larval shell (1.6 mm instead of 1.2 mm) and the suture is not distinctly channelled.

The larval development is planktotrophic (Thorson 1946), and we figure two newly settled larvae, without a trace of teleoconch growth (Figs 1858-59).

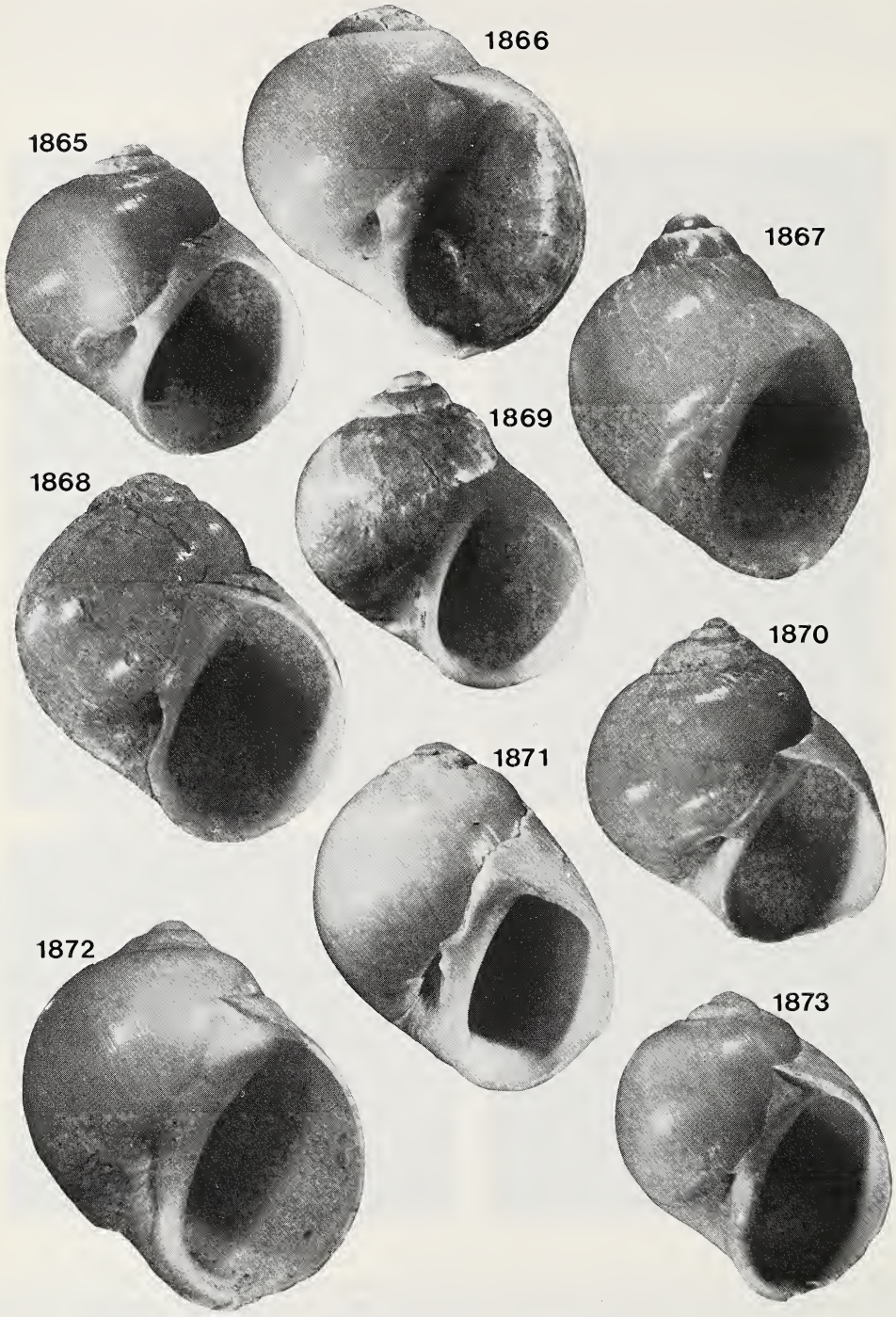




Figures 1858-1859. Newly metamorphosed larvae of *Polinices montagui*, INCAL st DS01. **1858**, protoconch I, scale line 50 μm. The arrow indicates the protoconch I - protoconch II demarcation. **1859**, newly metamorphosed larvae, height 1.55 mm, diameter 1.5 mm.



Figures 1860-1864. Protoconchs of naticids. **1860,** *Amauropsis sphaeroides*, DISCOVERY st 10112#2. **1861,** *Polinices fusca*, BALGIM st DW146. **1862,** *P. obtusa*, DISCOVERY st 9754#3. **1863,** *P. phaeocephala*, MONACO Exp st 703. **1864,** *P. phaeocephala*, BIACORES st 54. All scale lines 0.5 mm.


1866
1865
1867
1869
1868
1870
1871
1872
1873

Polinices subplicata (Jeffreys, 1885)
Figs 1805-1806, 1854, 1865-1871, 1875-1876, 1884, 1887-1888, 1903-1904, 1916

Natica subplicata Jeffreys, 1885:32, pl. 4 figs 2-2a.
Natica prosistens Locard, 1897:473, pl. 19 figs 32-35.
Natica extenta Locard, 1897:476, pl. 20 figs 7-10.
Natica extenta var. *major* Locard, 1897:477.
Natica amabilis Locard, 1897:482, pl. 20 figs 23-26.
Natica olivella var. *minor* Locard, 1897:480.

Type materials: N. subplicata, lectotype USNM 188539, several paralectotypes (mostly *Polinices fusca*), USNM 869480, 188540, 188541, 188542, 188543, 188544, and BMNH 1885.11.5.2478-2482, 2332-2334, 2321, 2382-2384, 2353; *N. prosistens*, lectotype, here designated, in MNHN; *N. extenta*, lectotype, here designated, in MNHN; *N. amabilis*, lectotype, here designated, in MNHN.

Type localities: N. subplicata, TRAVAILLEUR 1880, no station data, from the Bay of Biscay; *N. prosistens*, TRAVAILLEUR 1882 dr 18, 42°42' N, 09°36' W, 520 m; *N. extenta*, TALISMAN 1883 dr 33, 32°34' N, 09°49' W, 1590 m; *N. amabilis*, TRAVAILLEUR 1882 dr 19, 41°32' N, 09°21' W, 1350 m.

Material examined: The types and
-West of the British Isles. --DISCOVERY st 9753#7, 50°55' N, 12°11' W, 1942 m, 4 spms (SMNH); INCAL st OS07, 47°32' N, 09°34' W, 4249 m, 1 spm;
-Bay of Biscay. --THALASSA st X333, 44°11' N, 04°32' W, 1900-1950 m, 1 sh; st X334, 44°10' N, 04°52' W, 1900 m, 3 shs; st X336, 44°11' N, 05°11' W, 1950 m, 6 spms; st X337, 44°10' N, 05°15' W, 1935 m, 1 sh; st X340, 44°07' N, 04°30' W, 885 m, 1 sh; st Y373, 41°35' N, 09°19' W, 1200 m, 3 shs; st Z409, 47°43' N, 08°02' W, 1060 m, 1 sh; st Z415, 48°07' N, 08°26' W, 380 m, 2 spms (SMNH); st Z421, 48°23' N, 09°34' W, 950 m, 1 spm (SMNH); st Z426, 48°28' N, 09°39' W, 860 m, 2 shs; st Z435, 48°40' N, 09°53' W, 1050 m, 1 sh; st Z438, 48°34' N, 10°25' W, 1400 m, 2 shs; st Z457, 48°38' N, 09°53' W, 800 m, 2 shs; BIOGAS st CP07, 44°10' N, 04°16' W, 2170 m, 7 spms; st CP23, 44°05' N, 04°21' W, 1980 m, 1 sh; st CP25, 44°05' N, 04°17' W, 1894 m, 1 sh; st CW03, 47°31' N, 08°17' W, 1100 m, 1 sh; st DS52, 44°06' N, 04°22' W, 2006 m, 3 spms; st DS86, 44°05' N, 04°19' W, 1950 m, 1 spm; st DS87, 44°05' N, 04°19' W, 1894 m, 3 spms; SARSIA st 7606, 43°44' N, 03°47' W, 950 m, 1 sh; st 7610, 43°45' N, 03°49' W, 1100-1185 m, 4 spms; st 7614, 43°43' N, 03°38' W, 1100 m, 3 shs; st 7617, 43°42' N, 03°40' W, 900-1100 m, 2 shs; st 7627, 43°47' N, 03°46' W, 1925-1990 m, 2 spms; TRAVAILLEUR 1880 dr 2,6,7,9, 43°36-40' N, 04°15-35' W, 1019-375 m, 12 spms; TRAVAILLEUR 1882 dr 1, 44°07' N, 05°35' W, 564 m, 1 sh; dr 16, 42°48' N, 09°38' W, 264 m, 2 shs, det. *prosistens*;
-West of Spain and Ibero-Moroccan Gulf. --THALASSA st Y378, 41°34' N, 09°16' W, 1000 m, 3 shs; st Y380, 41°29' N, 09°15' W, 780 m, 2 shs; st Y395, 41°19' N, 09°14' W, 810 m, 1 sh; st Y401, 40°37' N, 09°22' W, 1040 m, 3 shs; st Y407, 40°34' N, 09°24' W, 740 m, 2 shs; --PORCUPINE Exp 1870 st 17, 39°42' N, 09°43' W, 1092-1993 m, 17 shs (coll. Sykes, BMNH); (Specimens reported by Jeffreys from PORCUPINE Exp 1870 st 4, 9, 13, 26, 30, belong to *Polinices fusca*. Those from st 1,

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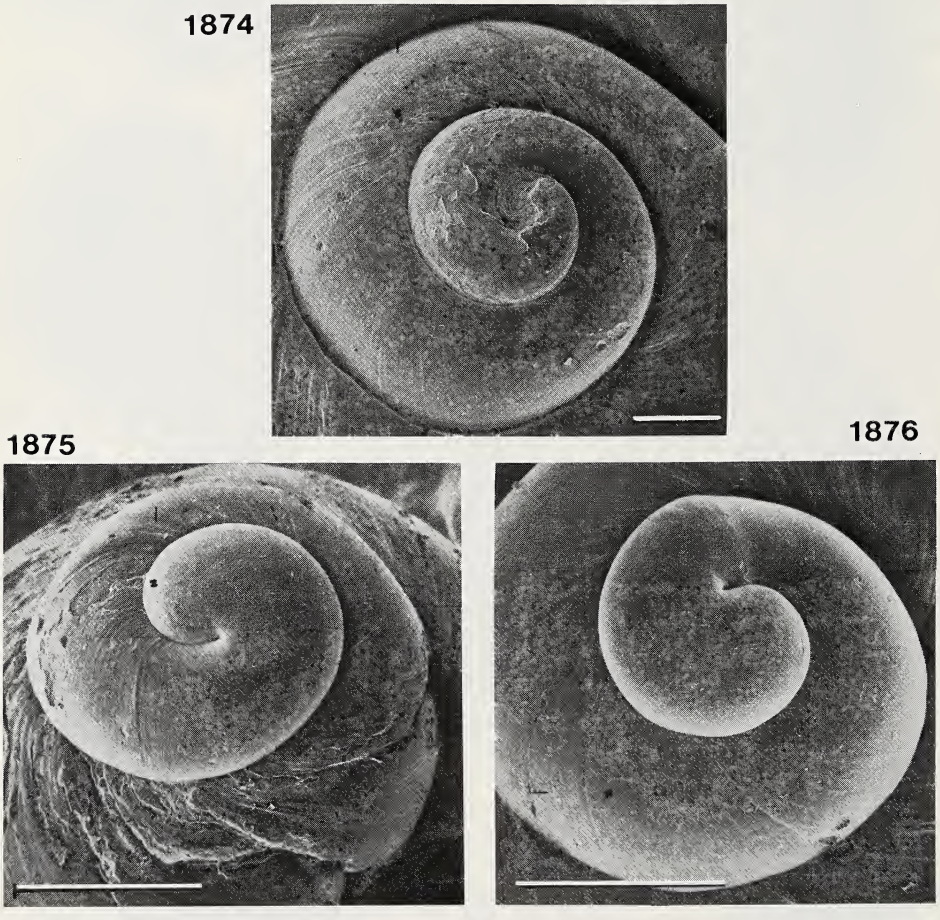
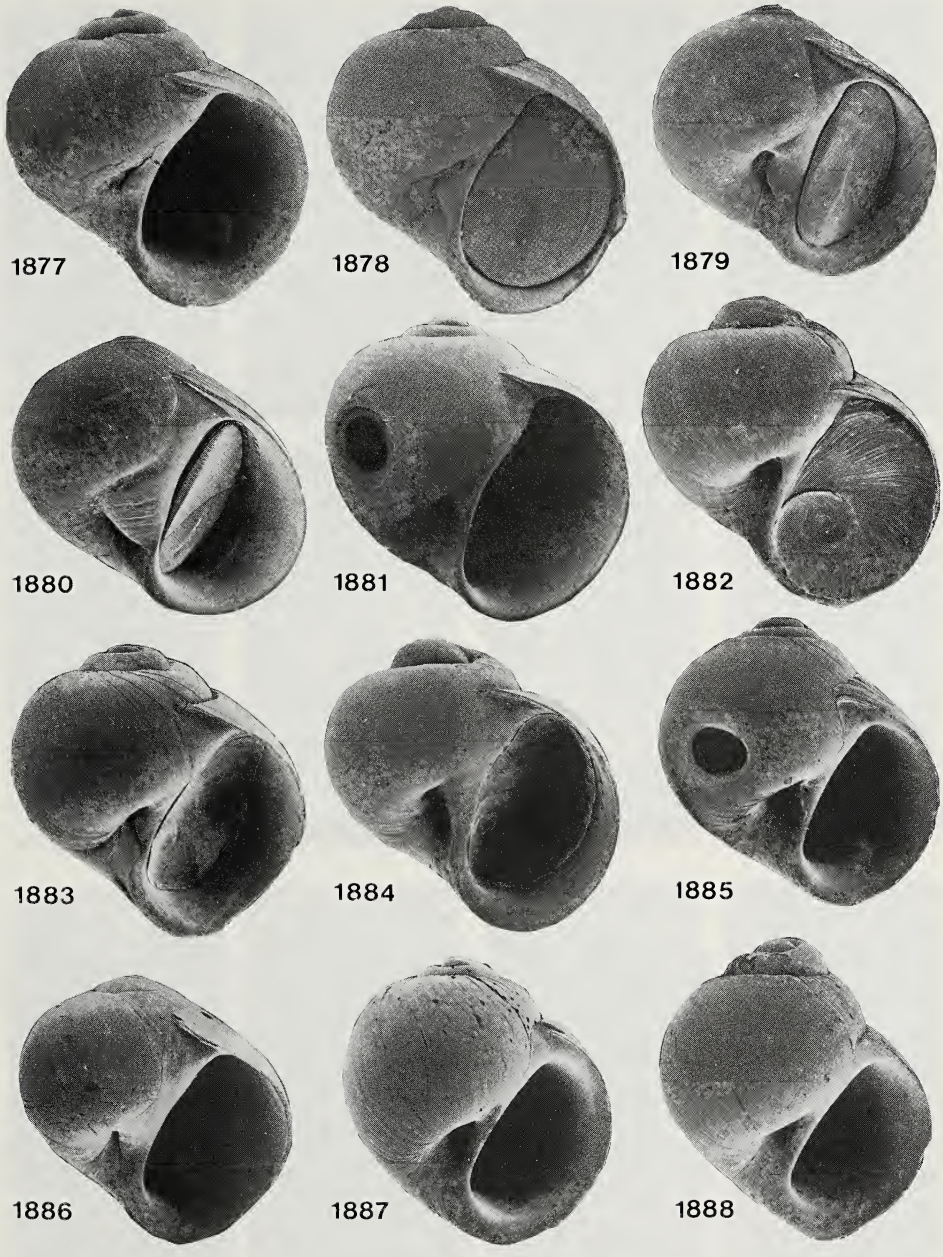
Figures 1865-1873. Genus *Polinices*. **1865,** *P. subplicata*, SARSIA st 7614, 7.6 mm. **1866,** *P. subplicata*, BIOGAS st CP25, 7.3 mm. **1867,** *P. subplicata*, off Madeira, 1970 m, 4.7 mm. **1868,** *P. subplicata*, TALISMAN dr 25, 11.9 mm. **1869,** *P. subplicata*, lectotype, 5.6 mm (USNM 188539). **1870,** *P. subplicata*, syntype of *Natica olivella* var. *minor*, 12.1 mm. **1871,** *P. "apora"* Locard, not Watson, TRAVAILLEUR 1881 dr 40, 8.6 mm. **1872,** *P. presubplicata*, holotype, 11.4 mm. **1873,** *P. presubplicata*, THALASSA st Y374, 8.6 mm.

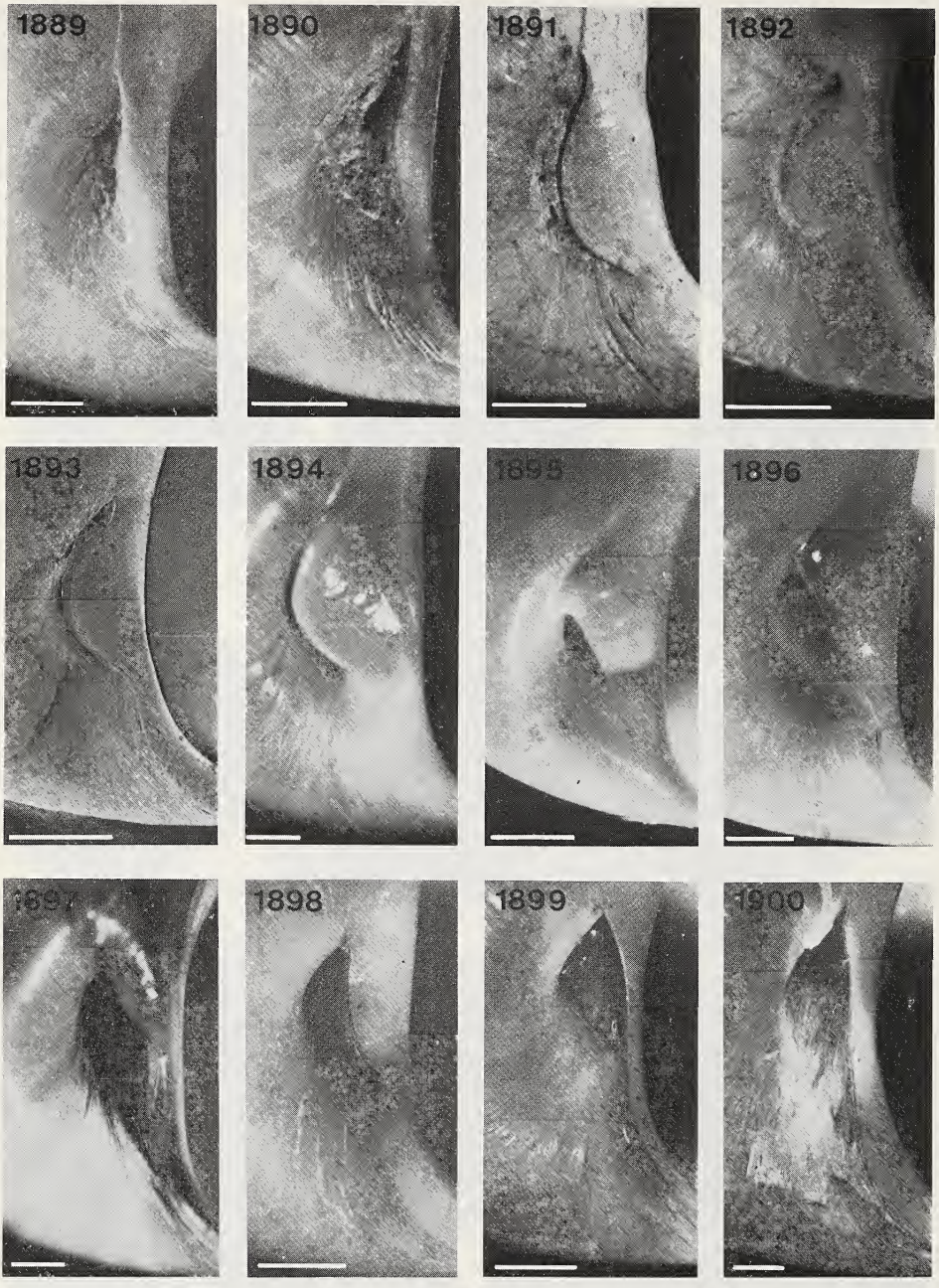
2, 3, Cape Espichel, 22 were not found); MONACO Exp st 2290, 43°46' N, 09°41' W, 1910-2320 m, 1 sh; JOSEPHINE Exp, 37°07-10' N, 09°18-25' W, 1438 m, 1 sh; SEAMOUNT st CP12, 36°24' N, 11°43' W, 1005-1040 m, 1 sh; --st CP30, 36°44' N, 11°23' W, 1940-2075 m, 3 shs; st DE48, 33°48' N, 14°32' W, 1350-1360 m, 3 shs; st DE82, 33°48' N, 14°24' W, 320-400 m, 1 sh; st DW108, 42°51' N, 11°53' W, 1110-1125 m, 1 sh; st DW116, 42°54' N, 11°51' W, 985-1000 m, 3 shs; --BALGIM st CP95, 34°24' N, 07°39' W, 1378 m, 4 shs; st DW96, 34°23' N, 07°40' W, 1235-1281 m, 4 shs; st DW100, 34°28' N, 07°42' W, 1680-1702 m, 1 spm; TRAVAILLEUR 1882, dr ?, 33°09' N, 09°38' W, 1900 m, 1 sh; MONACO Exp st 2048, 32°33' N, 17°02' W, 1968 m, 1 sh; TALISMAN 1883, dr 44, 30°03' N, 11°42' W, 2212 m, 2 shs; J. CHARCOT Madere, st 13, 1970 m, 2 shs; st 19, 990 m, 1 sh; st 49, 450-500 m, 3 shs; st 58, 410-580 m, 4 shs;



Figures 1874-1876. Protoconchs of *Polinices*. **1874,** *P. presubplicata*, THALASSA st Y374. **1875,** *P. subplicata*, off Madeira, 1970 m. **1876,** *P. subplicata*, TRAVAILLEUR 1880 dr 1. Scale lines 0.5 mm.



Figures 1877-1888. Shells of juvenile naticids. **1877,** *Cryptonatica affinis*, Bergen area, North of Marsteinen, 300-330 m, 2.7 mm. **1878,** *C. operculata*, SEAMOUNT st DW43, 3.4 mm. **1879,** *T. rizzae*, Ponta Delgada, Azores, 10-20 m, 4.4 mm. **1880,** *Tectonatica filosa, Ceuta*, Strait of Gibraltar, 5 mm. **1881,** *Euspira grossularia*, 17°54' N, 16°32' W, 200 m, 4.7 mm. **1882,** *Amauropsis sphaeroides*, INCAL st CP08, 2.6 mm. **1883,** *P. montagui*, Koster area, Sweden, 3.1 mm. **1884,** *Polinices subplicata*, DISCOVERY st 9357#7, 1.85 mm. **1885,** *P. fusca*, BALGIM st DW146, 2.3 mm. **1886,** *P. obtusa*, DISCOVERY st 9754#3, 3.9 mm. **1887,** *P. subplicata*, CANCAP st 2.065, 3.6 mm. **1888,** *P. subplicata*, CANCAP st 2.065, 3.3 mm.



Figures 1889-1900. Umbilici of naticids. **1889,** *Cryptonatica bathybii*, Norwegian Sea. **1890,** *C. bathybii*, Norwegian Sea. **1891,** *C. affinis*, Koster Area. **1892,** *C. operculata*, THALASSA st X362. **1893,** *C. operculata*, SEAMOUNT st DW43. **1894,** *Tectonatica filosa*, Ceuta. **1895,** *T. rizzae*, off Madeira. **1896,** *T. rizzae*, BIACORES st 89. **1897,** *Euspira grossularia*, Abene, southern Senegal. **1898,** *E. talismani*, holotype. **1899,** *Amauropsis brassiculina*, lectotype. **1900,** *A. sphaeroides*, INCAL st CP13.

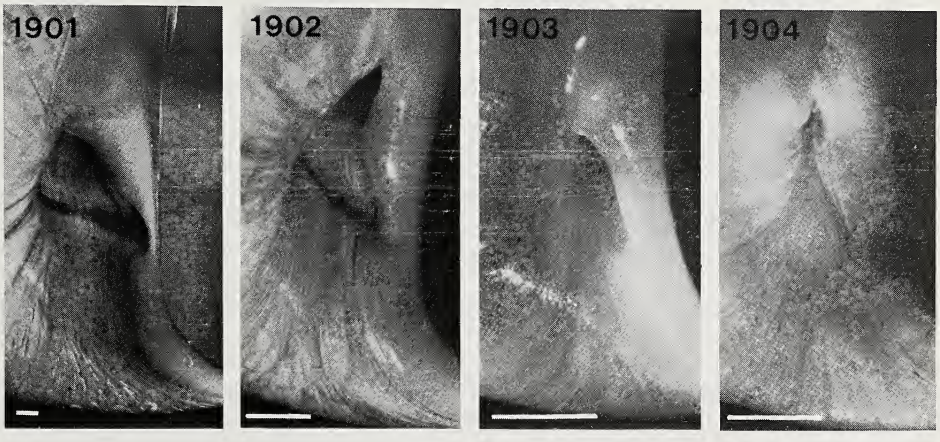
All scale lines 1 mm, except figs 1893 and 1895 (0.5 mm).

--Off NW Africa: CANCAP st 2.058, 27°58' N, 13°15' W, 500 m, 5 shs; st 2.065, 28°11' N, 13°57' W, 670 m, 15 shs; st 2.066, 28°11' N, 13°57' W, 886 m, 4 shs; st 2.067, 27°58' N, 14°12' W, 1820 m, 1 sh; st 3.071, 30°07' N, 15°54' W, 748 m, 1 sh; TALISMAN 1883 dr 74, 25°39' N, 15°58' W, 640 m, 1 spm; DISCOVERY st 8001, 22°35' N, 17°37' W, 1460 m, 1 spm; st 8003, 22°31' N, 17°21' W, 725-744 m, 2 spms; st 9134, 21°55' N, 18°02' W, 1945 m, 3 spms; st 9540, 20°56' N, 18°09' W, 2005 m, 1 spm.

Distribution: From off the southwestern part of the British Isles, along the European west coast, to off Mauritania (21°N), in 150-2500 m. Not in the Mediterranean.

Remarks: This species is highly variable and presents many taxonomic problems. The form on which Jeffreys based the name *subplicata* (Figs 1865, 1869) and which Locard named *amabilis* and *prosistens* is not rare in the Bay of Biscay and off northern Spain. We have seen no good specimens from western Spain and western and southern Portugal. Off western Morocco, the shell is more solid and ovate (Fig. 1867). This form was described as *N. extensa* by Locard and occurs also on the Gorringe Bank and around Madeira, down to a depth of 1900 m. It is characterized by having a bright yellowish brown protoconch. Specimens from Ilhas Selvagens agree well with those from further to the northeast, along the coast of Morocco, but some specimens differ in having flatter protoconch whorls. So do all our specimens from the Canaries, from a depth range of 500-900 m. This appearence of the protoconch is obvious in a single specimen from 22°N, 700 m, while it is not so in 2 specimens from deeper water (1400-2200 m) in the same area.

A useful guide for the identification is a low, indistinct tubercle on the parietal wall, where the inner lip leaves the contact with the preceding whorl. It may be difficult to detect, but can be seen if the light is parallel with the surface of the shell.



Figures 1901-1904. Umbilici of naticids. **1901,** *Polinices fusca*, Bay of Biscay. **1902,** *P. montagui*, Koster Area. **1903,** *P. subplicata*, SARSIA st 7614. **1904,** *P. subplicata*, THALASSA st Y374. All scale lines 1 mm.

Polinices phaeocephala (Dautzenberg & Fischer, 1896)Figs 1853, 1863-1864

Natica phaeocephala Dautzenberg & Fischer, 1896:458, pl. 19 fig. 14.
Natica phaeocephala: Dautzenberg 1927:143, pl. 4 fig. 16.

Type material: Lectotype, here selected, the shell figured by Dautzenberg & Fischer and one paralectotype, MOM.

Type locality: MONACO Exp st 233, 38°33' N, 28°09' W, 1300 m, Azores.

Material examined: The lectotype and --MONACO Exp st 211, 39°18' N, 31°12' W, 1372 m, 1 sh (IRSN); -- st 213, 39°23' N, 31°15' W, 1384 m, 1 sh; st 663, 37°29' N, 25°32' W, 1732 m, 3 shs (MOM); st 683, 38°20' N, 28°05' W, 1550 m, 1 sh; st 703, 39°21' N, 31°06' W, 1360 m, 8 shs (IRSN); --st 719, 39°11' N, 30°24' W, 1600 m, 8 shs (MOM); st 738, 37°40' N, 26°26' W, 1919 m, 1 sh, (MOM); st 3293, 38°47' N, 30°16' W, 1330 m, 1 sh (IRSN); BIACORES st 54, 38°12' N, 28°15' W, 1810 m, 1 sh; st 191, 37°56' N, 24°49.5' W, 1760-1650 m, 2 shs; TALISMAN 1883 dr 127, 36°11' N, 32°00' W, 1200-1500 m, 1 sh; dr 130, 37°35' N, 29°26' W, 789 m, 3 shs.

Distribution: Only known from the Azores, in 800-2000 m.

Remarks: Polinices phaeocephala closely resembles *P. subplicata* (Figs 1865-70) and there is a possibility that they are conspecific. However, the larval shell indicates lecithotrophic development in both species and since most Azorian mesogastropods with such development and not known from surrounding abyssal plains seem to be endemics, we prefer to keep *P. phaeocephala* as a distinct, allopatric species until we have evidence to the contrary.

Polinices phaeocephala can be identified by its conspicuous brown larval shell (Figs 1863-4) of about 1.0 whorl, similar to some morphs of *P. subplicata*, but has a narrower umbilicus and more evenly rounded shape, compared with that species. We have seen no live taken specimens.

Polinices presubplicata sp.n. Figs 1872-1874

Type material: Holotype and 8 paratypes in MNHN.

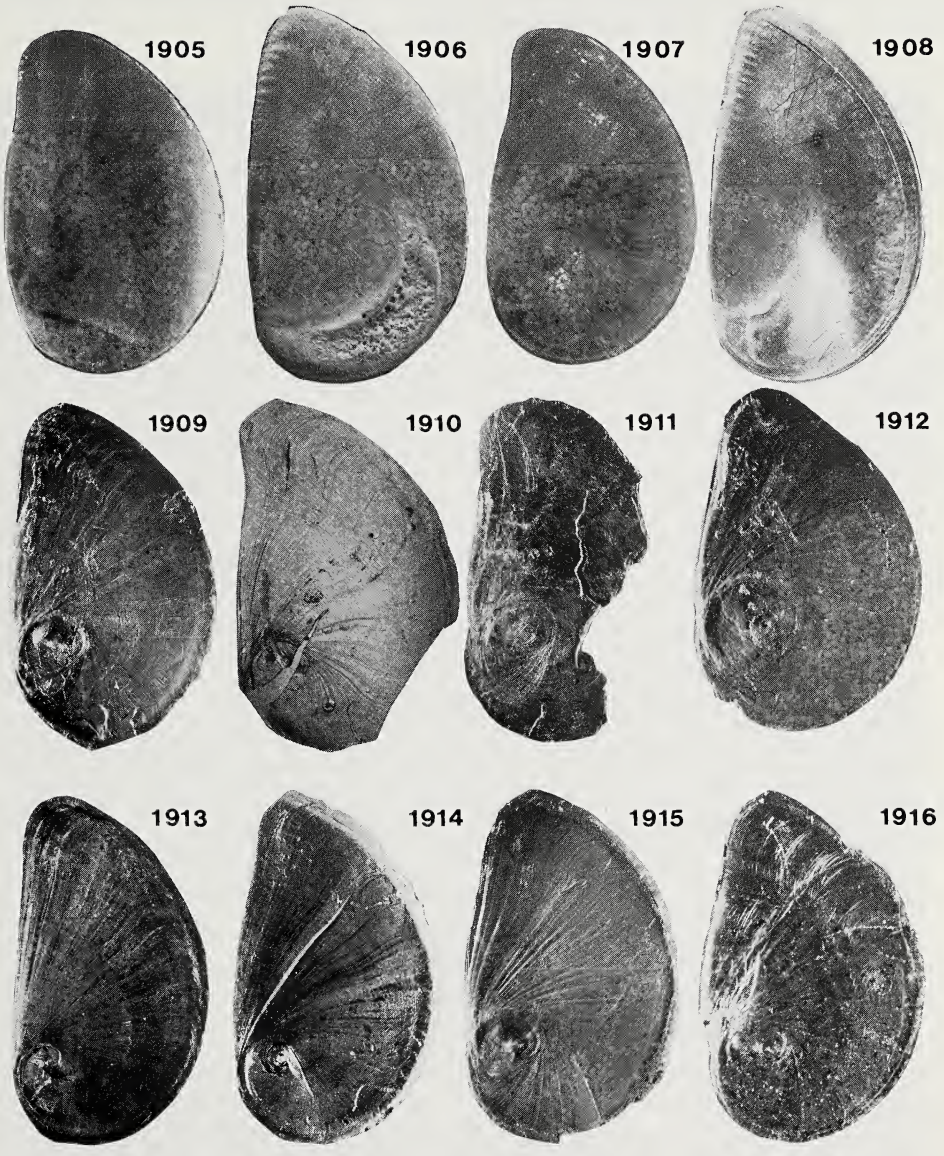
Type locality: THALASSA st Y374, 41°31' N, 09°20' W, 1250 m, off the Iberian Peninsula.

Material examined: The types and --THALASSA st W380, 41°29' N, 09°15' W, 780 m, 2 shs; st Y373, 41°35' N, 09°19' W, 1200 m, 1 sh; st Y395, 41°19' N, 09°14' W, 810 m, 1 sh; st Y400, 40°46' N, 09°19' W, 800 m, 1 sh; st Z451, 48°39' N, 10°37' W, 1400 m, 1 sh; st Z457, 48°38' N, 09°53' W, 800 m, 8 young, 1 adult;LAGARDERE st GCh23, 45°19' N, 03°12' W, 400-800 m, 1 sh; --st Gch26, 43°37' N, 01°56' W, 330-380 m, 1 sh.

Distribution: Off the northwestern part of the Iberian Peninsula and the Bay of Biscay in about 400-1200 m.

Description: Shell (Figs 1872-3) slightly pointed, globular, fairly solid, with distinct spire and narrow umbilicus. Larval shell (Fig. 1874), consisting of 1.5 convex whorls with traces of spiral lines, diameter 1.8 mm. Protoconch I and II not demarcated. Larval shell separated from from teleoconch by start of postlarval axial sculpture. Teleoconch with 2.5 slightly convex whorls, sulptured by oblique, axial incremental lines. Parietal callus solid and protruding. Inner lip solid, reflected over umbilicus, with some indistinct tubercles where inner lip leaves penultimate whorl.

Dimensions. Height of holotype 11.3 mm, diameter 9.6 mm; maximum height 14.9 mm.



Figures 1905-1916. Opercula of naticids. **1905,** *Cryptonatica affinis*, Tromsö, northern Norway, 7.1 mm. **1906,** *Tectonatica filosa*, Ceuta, Strait of Gibraltar, 6.0 mm. **1907,** *C. operculata*, THALASSA st W399, 3.4 mm. **1908,** *Tectonatica rizzae*, Azores, 4.7 mm. **1909,** *Euspira talismani*, holotype, 10 mm. **1910,** *E. grossularia*, off Luanda, Angola, 40-60m, 11.5 mm. **1911,** *Amauropsis brassiculina*, lectotype, 11 mm. **1912,** *A. sphaeroides*, INCAL st OS04, 4.9 mm. **1913,** *Polinices fusca*, Bay of Biscay, 21 mm. **1914,** *P. montagui*, Koster area, Sweden, 8.6 mm. **1915,** *P. obtusa*, INCAL st CP06, 8.4 mm. **1916,** *P. subplicata*, lectotype of *N. amabilis*, 4.4 mm.

Remarks: Polinices presubplicata resembles *subplicata* (Figs 1865-70), but has one additional whorl in the larval shell. It is not known from live taken specimens and the close similarity to *subplicata*, and the occurrence of other fossil gastropods at some of the localities make us suspect that this may be an extinct species and if so, perhaps an ancestor of *P. subplicata*. We have, however, decided to include it since we can not identify it with any known fossil naticid. The age is obviously difficult to estimate, but it seems unlikely that it would be older than Pliocene.

Family LAUBIERINIDAE

The family Laubierinidae contains three named species from the tropical and subtropical deep-sea. Two genera are included, *Laubierina* Warén & Bouchet, 1990 and *Akibumia* Kuroda & Habe, 1959. Only larval shells and juvenile specimens of *Laubierina* have been collected in the North Atlantic, but there are at least two species present in this area.

Larval shells of *Laubierina* (Fig. 1922) are characterized by their strong reticulate sculpture and large size, 3.0-5.5 mm. The larval shells of *Oocorys* (Fig. 1920) have a similar sculpture, but the axial ribs are orthocline, not prosocline as in *Laubierina*, they are considerably smaller (below 2.5 mm height), and the shape is more globular.

In larval shells of species of *Pisanianura* (Fig. 1921), which are very similar, the umbilicus is more narrow and sharply demarcated by a raised ridge, inside which the umbilical wall is smooth. Extralimital genera with similar protoconchs were discussed by Warén & Bouchet (1990).

Genus *LAUBIERINA* Warén & Bouchet, 1990

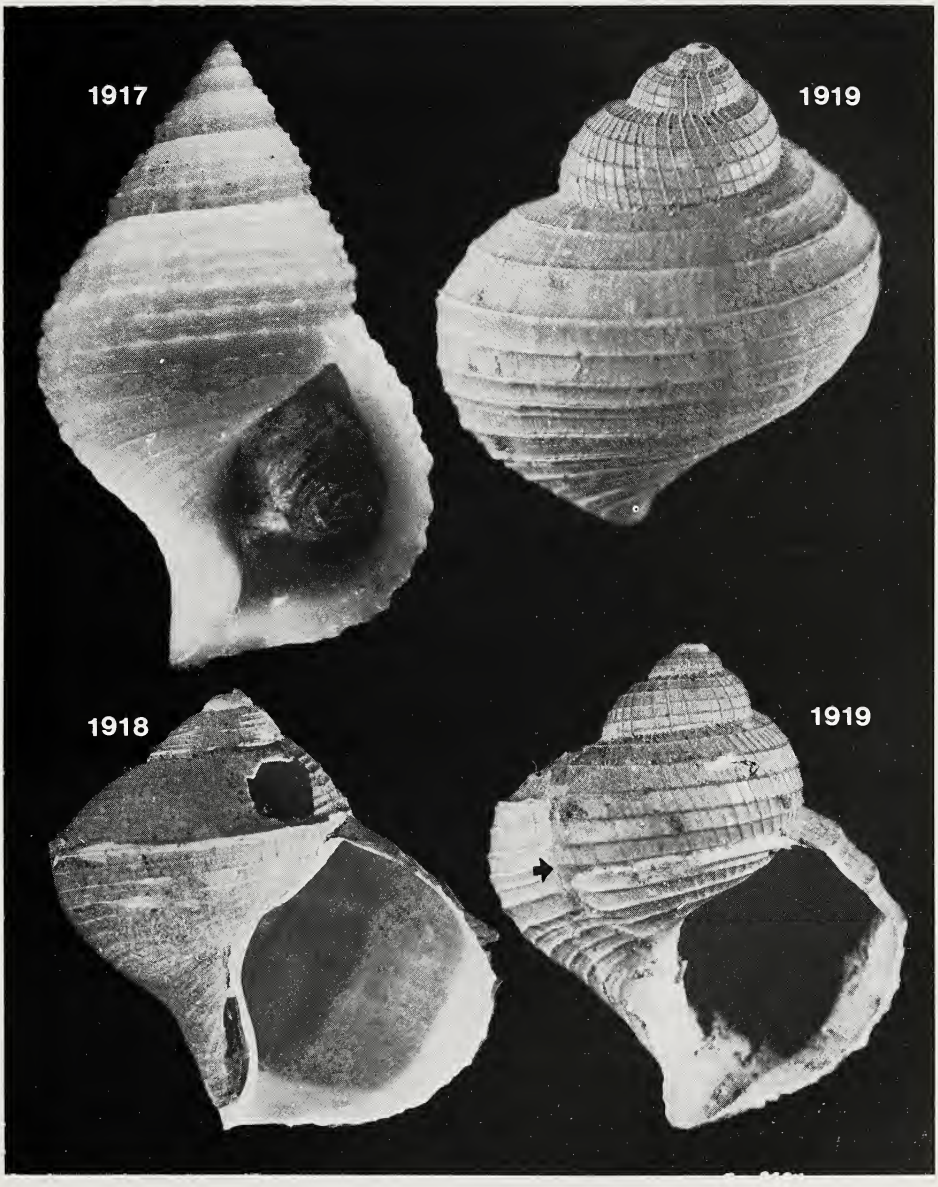
Laubierina Warén & Bouchet, 1990:71. Type species, by original designation, *L. peregrinator* Warén & Bouchet, 1990. Indian Ocean.

Laubierina sp. A — Figs 1919, 1922, 1926

Laubierina sp. A: Warén & Bouchet 1990:73, figs 105-108, 130-131.

Material examined: --JEAN-CHARCOT 1969, Madère st 13, 32°34' N, 17°04' W, 1970 m, 1 shell with 2/3 of a teleoconch whorl; CANCAP st 2.067, 27°58' N, 14°12' W, 2067 m, 2 larval shells; BIACORES st 195, 37°56' N, 24°49' W, 1700-1776 m, 1 larval shell; SEAMOUNT st CP30, 36°44' N, 11°23' W, 1940-2075 m, 14 larval shells and fragments, of which 2 with postlarval growth; SEAMOUNT st DW61, 36°40' N, 14°16' W, 200-205 m, 1 larval sh; SEAMOUNT st DE95, 35°05' N, 12°55' W, 197-210 m, 2 larval sh; Gulf of Mexico, 21°35' N, 96°55' W, 937 m, 1 shell with 2/3 of a teleoconch whorl (MNHN).

Remarks: This species differs from *L. peregrinator* (Fig. 1918) by having an evenly rounded first teleoconch whorl, sculptured with several strong spiral cords. It differs also from the material reported below as *L.* cf. *peregrinator* by having a larger protoconch (4.5-5.4 mm high and 3.9-4 whorls in protoconch II) with larger squares in the sculptural network. We consider the presently known shells insufficient for description.



Figures 1917-1919. Tonnoidea. **1917,** *Pisanianura grimaldii*, holotype, 27.6 mm. **1918,** *Laubierina peregrinator*, holotype, 18.8 mm. **1919,** *Laubierina* sp., 21°35' N, 96°54.6' W, 937 m, 13.2 mm. The black arrow indicates the protoconch - teleoconch demarcation.

Laubierina cf. *peregrinator* Warén & Bouchet, 1990

Laubierina cf. *peregrinator* Warén & Bouchet, 1990:71, figs 43-44, 128-129, 159-161.

Material examined: --SEAMOUNT st CP30, 36°44' N, 11°23' W, 1940-2075 m, 1 larval sh and 1 fragment with some postlarval growth (SMNH).

Distribution: Laubierina peregrinator (Fig. 1918) is known from the southeastern Atlantic and the southwestern Indian Ocean, in 2300-3550 m (Warén & Bouchet 1990).

Remarks: The two larval shells have a 3.1 mm high protoconch consisting of 3.1 whorls. The (worn) fragment of teleoconch has a strong peripheral keel and fainter spiral ridges. We cannot safely identify these specimens as *L. peregrinator* because specimens of *L. peregrinator* from the southern hemisphere have a larger protoconch, 5.5 mm high. From what can be seen on the fragment of teleoconch the adult sculpture is otherwise similar.

Family RANELLIDAE

Warén & Bouchet (1990) transferred *Pisanianura* from Buccinidae to Ranellidae, and erected Pisanianurinae. We refer to that paper for anatomical and taxonomical information and will only repeat the information regarding the area treated in this series. Beside *Pisanianura* and *Ranella*, the family is further represented worldwide in moderately deep water by species of *Argobuccinum*, *Fusitriton, Gyrineum* and *Sassia*.

Fechter (1975) described *Gyrineum atlanticum* from the Great Meteor Bank in 314-323 m. This nominal species has now been synonymized (Beu 1985) with *G. louisae* Lewis, 1974, originally described from the Indo-Pacific, and of too southern distribution to be included here.

For the history of the controversy regarding the family name, see Beu & Cernohorsky (1986) and Ponder & Warén (1988).

Genus *PISANIANURA* Rovereto, 1899

Anura Bellardi, 1873:201 (not *Anura* Hodgson, 1841). Type species, by subsequent designation (Cossmann 1901:178), *Murex inflatus* Brocchi, 1814. Italy, Plio-Pleistocene.
Pisanianura Rovereto, 1899:104, *nom. nov.* for *Anura* Bellardi, 1873.
Kaiparanura Laws, 1944; *Laminilabrum* Kuroda & Habe in Habe, 1961; *Nawenia* Ladd, 1977; See Warén & Bouchet 1990.

Pisanianura grimaldii (Dautzenberg, 1889) Figs 1917, 1921, 1929

Hindsia grimaldii Dautzenberg, 1889:33, pl. 2 fig. 4.
Anura clathrata Dautzenberg & Fischer, 1906:25, pl. 3 figs 6-8.

Type materials: H. grimaldii, holotype in MOM; *A. clathrata*, lectotype selected by Warén & Bouchet (1990) in MOM.

Type localities: H. grimaldii, MONACO Exp st 112, 38°39' N, 28°06' W, 1287 m, Azores; *A. clathrata*, MONACO Exp st 719, 39°11' N, 29°06' W, 1600 m, Azores.

Material examined: As listed by Warén & Bouchet (1990). (In the northeastern Atlantic known from 4 shells beside the types.)

Distribution: The northeastern Atlantic and southwestern Indian and Pacific Oceans, in 700-2200 m. We had previously overlooked the record by Bellon-Humbert (1974:51, pl. 12 fig. 75 as *Nucella lapillus*!) from off Casablanca, Morocco, 600 m.

Remarks. The larval shell of *Pisanianura* may be confused with that of *Laubierina*, for separation, see under *Laubierina* (page 790).

Genus *RANELLA* Lamarck, 1816

Ranella Lamarck, 1816:4. Type species, by subsequent designation (Children 1823, see Kennard *et al.* 1931:30), *Ranella gigantea* Lamarck, 1816. Mediterranean.
Gyrina Schumacher, 1817; *Eugyrina* Dall, 1904; *Mayena* Iredale, 1917; *Gyrinopsis* Dall, 1925; see Beu (1976:300; 1988:75).

Remarks: The genus *Argobuccinum* Herrmannsen, 1846 has frequently been used in the European literature for *Ranella olearia/gigantea*. Its type species is *Argobuccinum argus* (Gmelin, 1791) and it is not a synonym of *Ranella* (see Smith 1970).

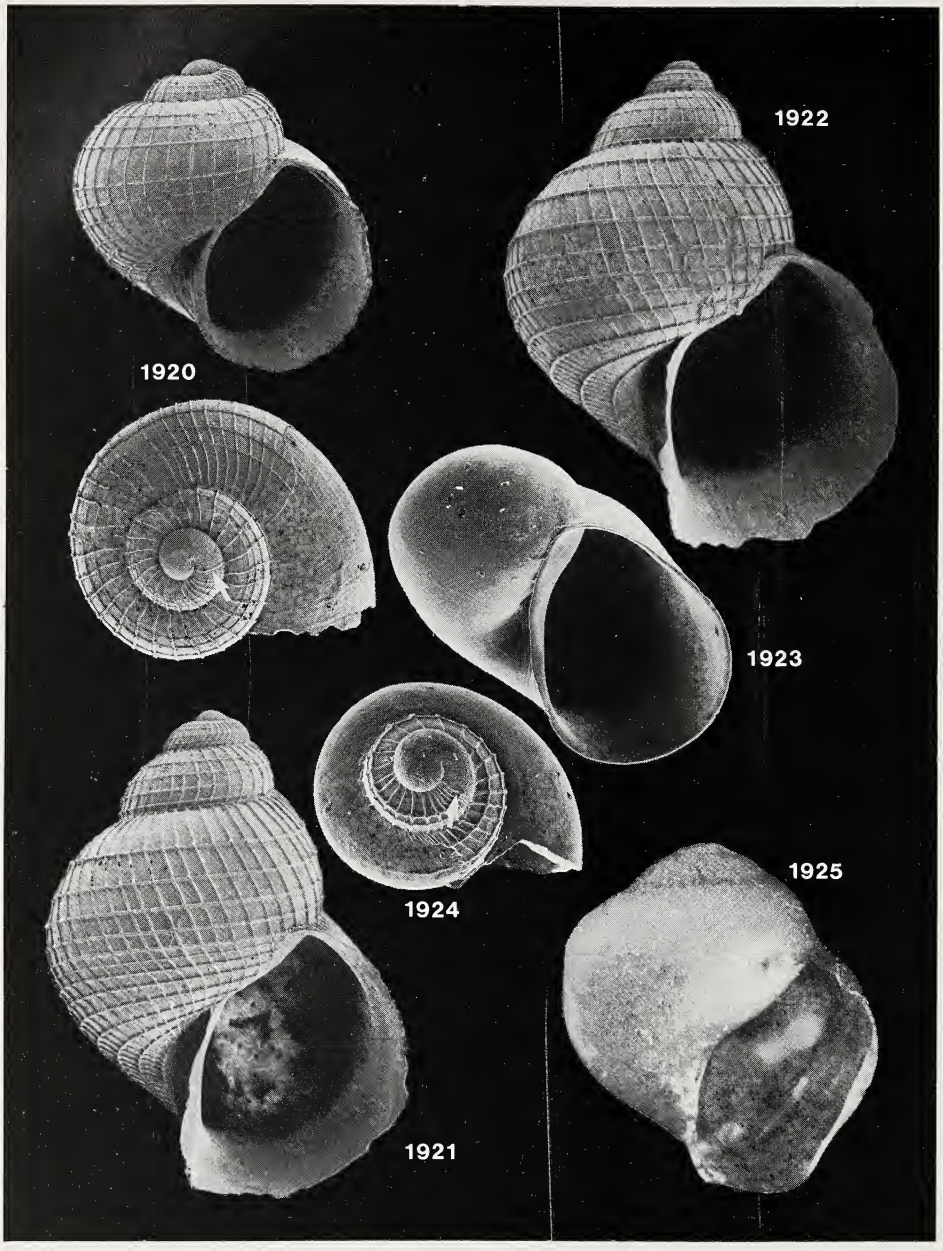
Ranella olearia (Linné, 1758) Figs 1948-1949

Murex olearium Linné, 1758:748.
Ranella gigantea Lamarck, 1816:pl. 413 fig. 1.
Ranella reticularis var. *borniana, bicanalata, mediterranea*, and *parivaricata* de Gregorio, 1884:109-110.
Ranella gigantea var. *atlantica* Monterosato, 1890:164.
Argobuccinum giganteum var. *oceanica, curvicauda, magnifica, tenuis, intusdentata, nodosecarinata, dilatata* Coen, 1941:174-175.
Argobuccinum giganteum exilis, nodosum, rarituberculata, duplonodosum, inflatum Settepassi, 1970 (also quadri- and pentanominal names which have no nomenclatorial standing).
Dell & Dance (1963), Kilias (1973) and Beu (1978) list synonyms and references from other parts of the world.

Type material: M. olearium, Clench & Turner (1957:228) designated Gualtieri's (1742) pl. 50 fig. A, to be the "type figure" of *Murex olearium*, but we do not know if that specimen remains in the still existent Gualtieri collection. A Linnean shell of *Murex olearium* in the collection of the Linnean Society of London was figured by Dell & Dance (1963).

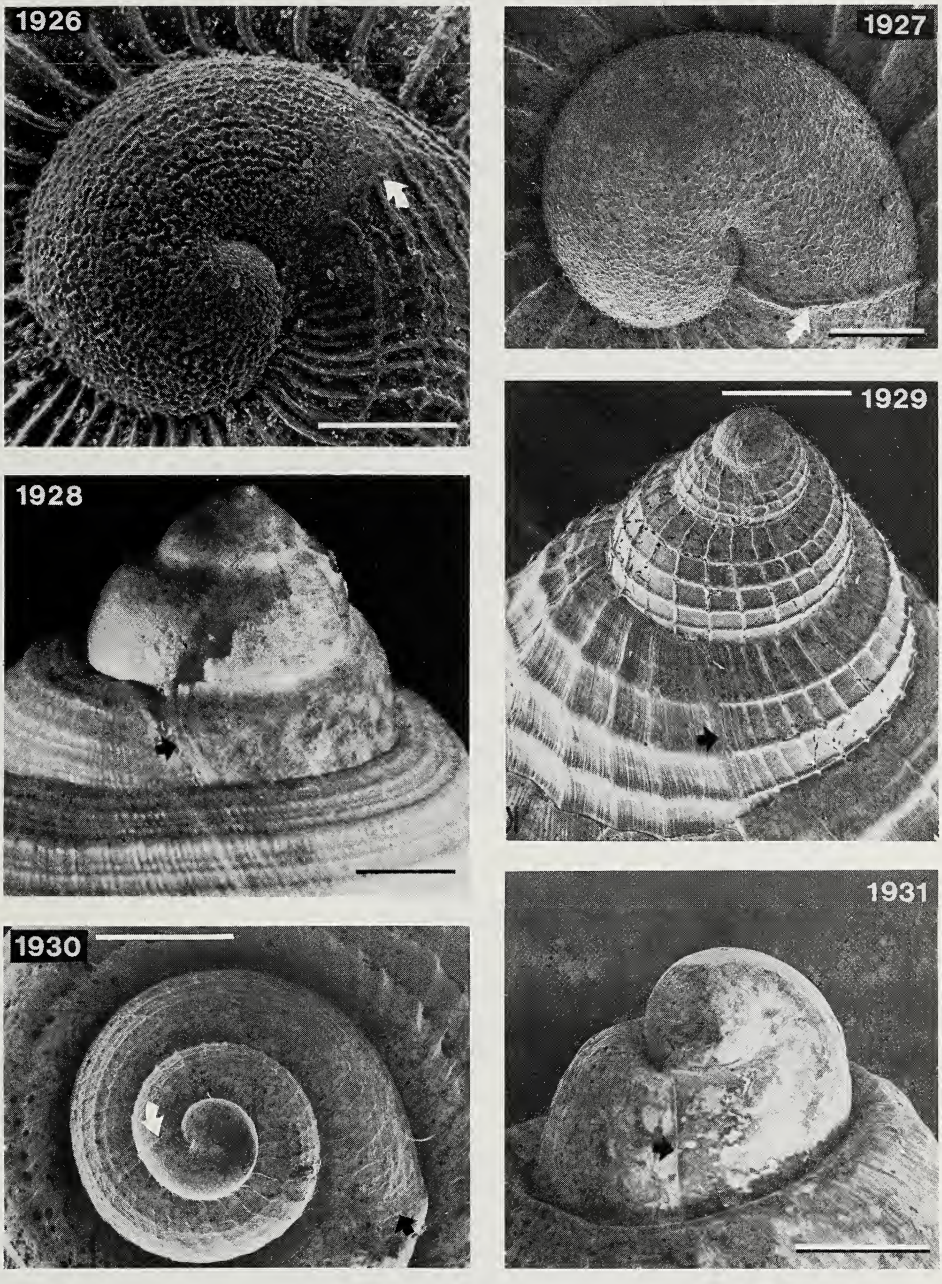
Type locality: M. olearium, "Europa australis, M. Mediterraneo".

Material examined:
-South of Great Britain and Ireland. --PROCELT 1 st K194, 51°44' N, 11°48' W, 605-609 m, 1 sh; st K195, 51°22' N, 11°31' W, 365 m, 1 spm;



Figures 1920-1925. Larval shells of Tonnoidea. **1920,** *Oocorys sulcata*, SEAMOUNT st DW116, 2.0 mm. **1921,** *Pisanianura grimaldii*, SEAMOUNT st CP30, 3.1 mm. **1922,** *Laubierina* sp., SEAMOUNT st CP30, 4.8 mm. **1923,** *Galeodea echinophora*, Calvi, Corsica, maximum length 1.4 mm. **1924,** *Eudolium bairdii*, BIACORES st 161, diameter 1.0 mm. **1925,** *Cithna olivacea*, holotype, height 3.6 mm (USNM 38237).

The white arrows indicate the protoconch I - protoconch II demarcation.



Figures 1926-1931. Protoconchs of Tonnoidea. **1926,** *Laubierina* sp., BIACORES st 195. **1927,** *Oocorys sulcata*, SEAMOUNT st DW116. **1928,** *Eudolium bairdii*, BIACORES st 161. **1929,** *Pisanianura grimaldii*, 12°27' S, 40°10' E, 680-700 m. **1930,** *Oocorys cancellata*, 24°14' N, 76°06' W, 1778-1788 m. **1931,** *Galeodea echinophora*, Calvi, Corsica.

Scale lines 1 mm (1928, 1929), 500 μm (1930, 1931), 100 μm (1926, 1927).

The white arrows indicate the protoconch I - protoconch II demarcation. The black arrows indicate the protoconch II - teleoconch demarcation.

-Northern part of the Bay of Biscay. 8 lots (20 spms and shs) between 48 and 49 N, 256-699 m.
-W European continental slope. --18 lots (40 spms and shs) from depths between 110 and 1140 m (alive).
-Azores. --16 lots (62 spms and shs) from depths between 130 and 800 m.
-Mediterranean. --9 lots (18 spms and shs) from the western Basin, mostly poorly localized, ascertained depth down to 400 m.
-West Africa. --Morocco, 3 lots (3 spms); Mauretania, 10 lots (19 spms); Senegal, 5 lots (9 spms); Angola, 3 lots (3 spms).

Distribution: Common, although rarely abundant, on the deep shelf and upper slope, from southwestern Ireland (earlier records discussed by O'Riordan 1972) along the East Atlantic continental slope, with numerous records as far south as Senegal; common at the Azores in 200-600 m; Mediterranean, where it is more common in the western basin. The distribution outside the northeastern Atlantic was reviewed by Cosel (1983) and Beu (1985). Scattered records exist from the western Atlantic and Caribbean, southeastern Atlantic and South Africa, the islands in the southern Indian Ocean, and numerous records from New Zealand.

Remarks: Although this species, following Born (1780), sometimes is identified as *"Ranella/Triton reticularis* (Linné)", the name *Murex reticularis* Linné, 1758 has been restricted to an Indo-Pacific species of *Distorsio* (Beu 1987:314).

From the list of European varietal names, only *mediterranea* de Gregorio, 1884, *atlantica* Monterosato, 1890 and *oceanica* Coen, 1941 can be regarded of subspecific rank. All others should be regarded as infrasubspecific.

We give only two figures of this well known, not remarkably variable species (Figs. 1948-9). For illustration of individual variants from European waters, see Coen (1941), Dell & Dance (1963) and Settepassi (1970).

Specimens from the Azores (Fig. 1949) do not exceed 80 mm, but are otherwise similar to East Atlantic specimens (Fig. 1948). We do not consider that the Atlantic and Mediterranean specimens differ enough to justify recognition of two subspecies as had been advocated by various authors in the past (Monterosato 1890, Locard 1897, Dautzenberg 1927, Coen 1941).

Family BURSIDAE

There are no deepwater bursids known from the northeastern Atlantic. *Talisman parfaiti* de Folin, 1884 was described from specimens taken by the TALISMAN Exp (1883), presumably from deep water, although de Folin gives no station number. Warén & Bouchet (1990) identified the type material as bursid larval shells.

Family TONNIDAE

Marshall (1992) has revised the species of *Eudolium*, the only deep-water tonnid genus. We thank him for sharing his results with us before publication. Cernohorsky (1976) listed the nominal species of *Eudolium*.

Genus *EUDOLIUM* Dall, 1889

Doliopsis Monterosato, 1872:49 (not *Doliopsis* Vogt, 1852). Type species, by monotypy, *Dolium crosseanum* Monterosato, 1869. Mediterranean.
Eudolium Dall, 1889:232, *nom. nov.* for *Doliopsis* Monterosato, 1872.
Galeodolium Sacco, 1891:4. Type species, by subsequent designation (Cossmann 1903:139), *Cassidaria mutica* Michelotti, 1861. Italy, Oligocene.

Remarks: Galeodolium, Tuberculodolium and *Simplicodolium* were included by Cossmann (1903), Wenz (1941) and Turner (1948) in the synonymy of *Eudolium*. Their type species were recently illustrated by Ferrero Mortara *et al.* (1984) and their status can now be reevaluated.

Tuberculodolium was described by Sacco (1891:9). *Eudolium antiquum* Sacco, 1891 is the type species, by subsequent designation by Cossmann (1903:139) from the Italian Oligocene. The holotype (Ferrero Mortara *et al.* 1984:pl.3 fig. 5) is a poorly preserved juvenile shell that is more slender than any Recent species of *Eudolium* and we question that they are congeneric.

Simplicodolium was described by Sacco (1891:13) from the Italian Mio-Pliocene with *Pyrula fasciata* Borson, 1821 as type species by monotypy. A lectotype was selected and illustrated by Pavia (1976). His illustrations seem to show a young *Tonna* rather than *Eudolium*.

Galeodolium Sacco, 1891, we agree to be a synonym of *Eudolium*.

Specimens of *Eudolium* are very rare in the eastern Atlantic, and exceedingly rare in the Mediterranean, whereas they are locally common in the West Atlantic. There are 77 lots and 136 specimens in USNM. It is possible that the Mediterranean, and perhaps also the East Atlantic specimens represent pseudopopulations maintained by larvae from the western Atlantic (Bouchet & Taviani 1992).

One abyssal record (TALISMAN dr 134, 42°19' N, 21°16' W, 4010-4060 m, Azores; Locard 1897 erroneously cites this record from dr 139, and gives the depth for dr 134) of *Eudolium crosseanum* is repeatedly cited, but the specimen (in MNHN) belongs to *Teretiopsis*(Turridae). There are thus no records from the northeastern Atlantic deeper than 850 m.

Eudolium crosseanum (Monterosato, 1869) Fig. 1935

Dolium crosseanum Monterosato, 1869:228, pl. 12 fig. 1.
Eudolium thompsoni McGinty, 1955:80, pl. 1 figs 5-6 (synonymized by Marshall 1992).

Type material: D. crosseanum, holotype HUJ 21386, figured by Piani (1977:35, fig. 10 as Coen no. 2521).

Type locality: D. crosseanum, from fishermen, Palermo, Sicily.

Material examined: The holotype of *D. crosseanum* and several western Atlantic lots in USNM.

Distribution: The Atlantic distribution is reviewed by Marshall. The only Mediterranean record appears to be the shell described by Monterosato more than 120 years ago.

Remarks: Piani (1977) described the history of the two shells originating from Monterosato, now in ZMR and HUJ. Both had been considered by the curators of these museums to be the holotype. Judging from published photographs (Coen 1930, Piani 1977), we conclude that two species are involved. The shell in Jerusalem is mottled and conspecific with *E. thompsoni*, described from the western Atlantic (Fig. 1935). The shell in Roma has spiral cords on the shoulder of the body whorl which are slightly nodulous. This specimen is conspecific with *E. bairdii* from the western Atlantic

(Fig. 1932). Piani noted that both of these shells were slightly smaller than the size given in the original description (76-77 mm and 74 mm respectively; 81 mm given in the original description). He "redesignated as holotype the specimen figured by Coen (fig. 6), now kept in Israel" (translated).

We have examined the shell in HUJ and agree with Marshall that this is the specimen described by Monterosato. The characterization of the shell as " mottled" and the shape of the columellar callus in the drawing agree only with specimen in HUJ, while the specimen in ZMR belongs to *E. bairdii*.

Coen (1930) recorded one fragment of *E. crosseanum* from Alberoni, in the Adriatic. We have examined it (HUJ 23332), and it proved to be an apex of *Galeodea echinophora.*

Eudolium bairdii (Verrill & Smith, 1881) Figs 1924, 1928, 1932-1934

Dolium bairdii Verrill & Smith in Verrill, 1881:299; Verrill 1884:253, pl. 29 figs 2a-b.
Dolium crosseanum var. *solidior* Dautzenberg & H.Fischer, 1906:38, pl. 3 fig. 1.

Type materials: D. bairdii, holotype USNM 51385; *D. crosseanum* var. *solidior*, holotype in MOM.

Type localities: D. bairdii, USFC st 945, 39°58' N, 71°13' W, 377 m, off New England; *D. crosseanum* var. *solidior*, MONACO Exp st 866, 38°53' N, 27°23' W, 599 m, Azores.

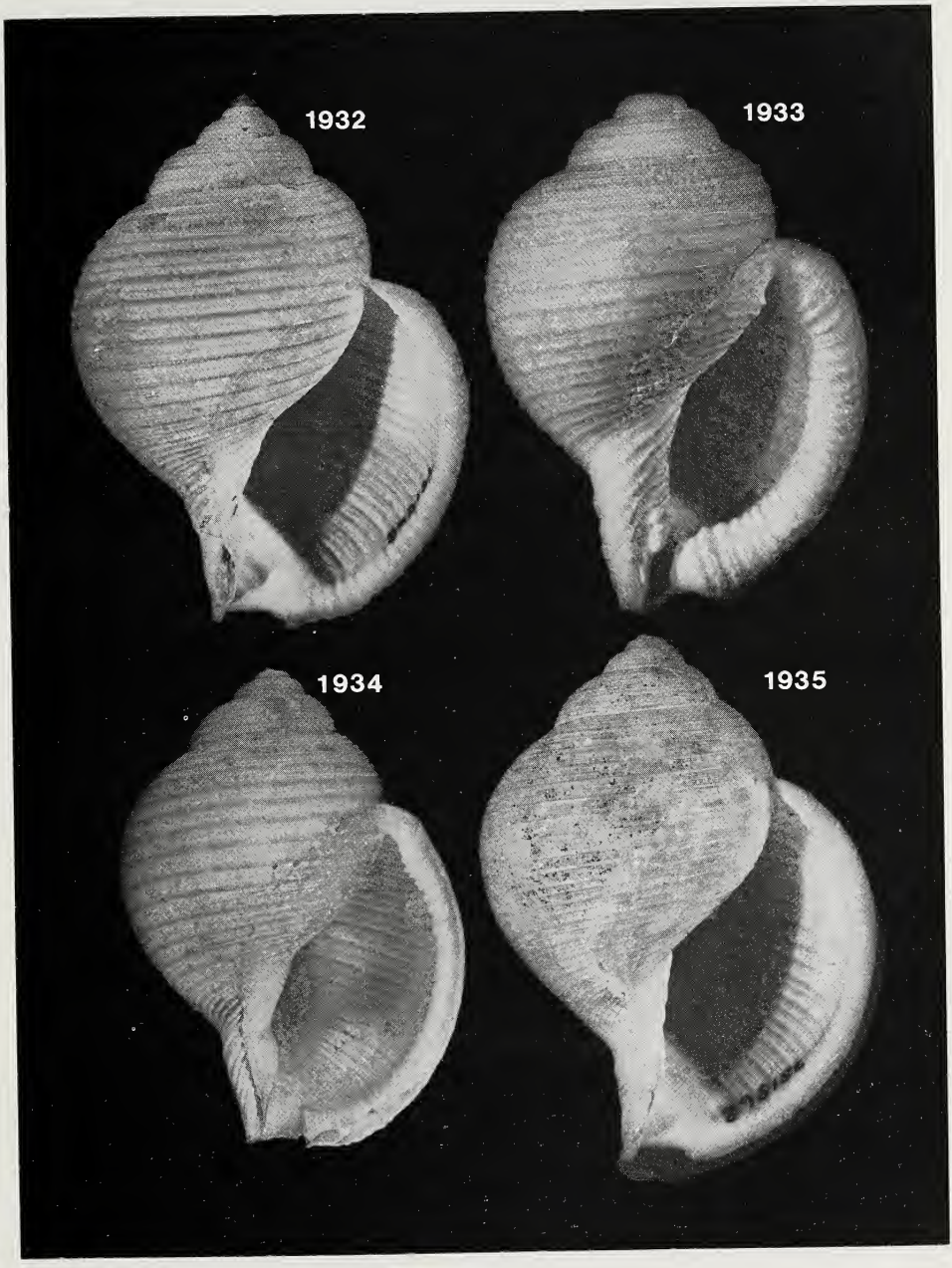
Material examined: The type material and MONACO Exp st 1114, 33°59' N, 08°13' W, 851 m, 1 sh; st 1118, 29°06' N, 13°03' W, 1098 m, 1 old fragm; BALGIM st CP90, 34°21' N, 07°42' W, 885-895 m, 1 sh; TALISMAN dr 63, 26°18' N, 14°52' W, 640 m, 1 sh; BIACORES st 161, 37°39' N, 25°50' W, 590 m, 1 small spm (Warén & Bouchet 1990:figs 78-79 as *E. crosseanum*); numerous lots from the West Atlantic (USNM) and off South Africa (SAM).

Distribution: The western Atlantic and the Indo-Pacific region are reviewed by Marshall (1992). In the eastern Atlantic it is known from Morocco and the Azores, in about 600-900 m depth. In the Mediterranean, only the shell in the Monterosato collection in ZMR (Piani 1977:fig. 11) and the two shells reported by Piani (1977:figs 1-2) from southeastern Sicily are likely to be of Mediterranean origin.

Remarks: Eudolium solidior (Fig. 1933) has generally been considered to be distinct from *bairdii* (Figs 1932, 1934), and a generic position in *Oocorys* has been suggested. Examination of a large series of specimens from the western Atlantic (specimens in USNM) revealed no consistent differences between *solidior* and *bairdii*, in the solidity of the shell.

Most specimens were intermediate and the types represent the extremes of the variation. Thick shells of *solidior* are usually smaller (ca. 45 mm vs. up to 85 mm in specimens with thinner shells) and may simply be specimens that have had growth problems.

Eudolium bairdii differs from *E. crosseanum* by having coloured spiral cords instead of being mottled, and by having a different arrangement of the spiral sculpture. In *bairdii* there are some stronger, first order, spiral cords with interspaced weaker (second order) raised cords, which usually are light amber brown. The rest of the shell is lighter beige. The cords on the shoulder of the body whorl (sometimes also penultimate whorl) are somewhat undulating and have a tendency to form small nodules. In *crosseanum* the spiral cords are uneven but never regularly alternating between first and second order ribs and they are not undulating on the shoulder. Furthermore, the spiral cords do not differ from the background colour, and the whole shell is mottled with light pinkish brown on a beige background.



Figures 1932-1935. Genus *Eudolium*. **1932,** *E. bairdii*, Gulf of Uraba, Colombia, 08°48' N, 76°53' W, 50 m, height 82 mm (USNM 751868). **1933,** *E. bairdii*, form solidior, MONACO Exp st 866, 41.4 mm. **1934,** *E. bairdii*, BALGIM st CP90, 70 mm. **1935,** *E. crosseanum*, same data as fig. 1932.

Family CASSIDAE

This is predominantly a shelf and shallow-water family. The genus *Oocorys* contains 6-10 species on the continental slopes and abyssal plains of the oceans of the world. *Oocorys sulcata* is herein recorded from a depth of 5073 m in the North Atlantic, which is the deepest record of the family. The genus *Galeodea* is rich in species in Paleogene deposits of the northern hemisphere, but comprises only six Recent species. These live mostly on the deep shelf and continental slope. A few other cassid genera (*Dalium* Dall, 1889, *Echinophoria* Sacco, 1890, *Galeoocorys* Kuroda & Habe, 1957, and *Hadroocorys* Quinn, 1980) are represented in deep-sea faunas of tropical regions.

We have recently published (Warén & Bouchet 1990) about the anatomy and radula of *Oocorys* and *Galeodea*, and we refer to this paper for a discussion of their systematic position.

In addition to the species treated below, *Oocorys alboranensis* Settepassi, 1970 was described from the Alboran Sea in 200 m. We have examined the holotype in Museo di Zoologia, Roma and conclude that it is only an individual variation of *Galeodea echinophora*.

Genus *OOCORYS* Fischer, 1883

Oocorys Fischer, 1883:392. Type species, by monotypy, *O. sulcata* Fischer, 1883. Eastern Atlantic.
Benthodolium Verrill & Smith in Verrill, 1884:177. Type species, by monotypy, *B. abyssorum* Verrill & Smith, 1884. Western Atlantic.

Remarks: We consider *Benthodolium abyssorum* and *Oocorys sulcata* to be synonyms (see below), and follow Quinn (1980:151) in synonymizing the genera on which they are based.

Oocorys sulcata Fischer, 1883 Figs 1920, 1927, 1936-1943

Oocorys sulcata P. Fischer, 1883:392; 1885:769, fig. 536.
Benthodolium abyssorum Verrill & Smith, 1884:177, pl. 31 fig. 12.
Oocorys fischeri Locard, 1897:291, pl. 15 figs 7-9.
Oocorys fischeri var. *minor* Locard, 1897:292.
Oocorys sulcata var. *minor* and var. *elongata* Locard, 1897:291.
Oocorys watsoni Locard, 1897:290.
Oocorys umbilicata Quinn, 1980:151, figs 1C, 2A-B, 3, 4.

Type materials: O. sulcata, lectotype, here selected, the shell figured by Locard (1897) in MNHN; *B. abyssorum*, holotype USNM 35273, paratype USNM 35364; *O. fischeri*, lectotype, here designated, in MNHN; *O. watsoni*, holotype in BMNH (uncat.); *O. umbilicata*, holotype USNM 784592.

Type localities: O. sulcata, lectotype from TALISMAN dr 130, 37°55' N, 27°02' W, 2235 m, Azores; *B. abyssorum*, ALBATROSS st 2098, 37°40' N, 70°37' W, 4042 m, off Virginia, USA; *O. fischeri*, the lectotype has two labels, one with dr 38, 2200 m, one with dr 76, 2518-2638 m; *O. watsoni*, CHALLENGER st 106, 01°47' N, 24°26' W, 3367 m, mid Central Atlantic; *O. umbilicata*, COLUMBUS ISELIN st CI-306, 24°06' N, 77°18' W, 1379-1408 m, Bahamas.

Material examined: The types of *sulcata, abyssorum, fischeri* and *watsoni* and:
-Azores. --MONACO Exp st 244, 38°34' N, 28°19' W, 1266 m, 2 shs (IRSN, MOM); st 536, 37°54'

N, 24°43' W, 2178 m, 1 sh (MOM); st 553, 37°43' N, 25°05' W, 1385 m, 1 sh (MOM); st 652, 36°55' N, 22°23' W, 4261 m, 1 sh (MOM); st 719, 39°11' N, 29°06' W, 1600 m, 2 + 2 old shs (MOM, MNHN); st 738, 37°40' N, 26°26' W, 1919 m, 1 sh (MOM); st 743, 37°36' N, 25°17' W, 1494 m, 1 sh (MOM); st 1311, 37°37' N, 25°21' W, 1187 m, 2 shs (IRSN, MOM); st 1338, 38°41' N, 28°45' W, 950 m, 1 sh (MOM); st 1349, 38°35' N, 28°06' W, 1250 m, 1 sh (MOM); st 3293, 38°47' N, 30°16' W, 1331 m, 1 sh (IRSN); TALISMAN dr 127, 38°38' N, 28°21' W, 1258 m, 1 sh, 1 fragm; BIACORES st 66, 38°34' N, 28°19' W, 1225-1260 m, 1 sh; st 95, 39°03' N, 28°25' W, 2440 m, 1 sh; st 163, 37°26' N, 26°02' W, 2330-2370 m, 7 shs; st 176, 38°00' N, 26°21' W, 2440-2720 m, 2 shs; st 179, 38°05' N, 25°46' W, 1590-1665 m, 1 sh; st 180, 37°57' N, 25°33' W, 1069-1235 m, 1 sh; st 202, 37°36' N, 24°59' W, 2850 m, 1 spm, 5 shs.

-Bay of Biscay. --MONACO Exp st 1546, 46°47' N, 05°18' W, 800 m, 1 fragm (MOM); st 2990, 43°45' N, 09°41' W, 2320 m, 3 shs (IRSN, MOM, MNHN); BIACORES st 251, 47°38' N, 08°56' W, 3360-3600 m, 2 spms; BIOGAS st CP1 and st CV39, 47°32' N, 08°40' W, 2245-2350 m, 4 shs; st CP33, 47°33' N, 08°39' W, 2115 m, 1 sh; st CV24, 47°34' N, 08°34' W, 2025 m, 1 spm; st CP11, 47°30' N, 09°07' W, 3056 m, 1 sh; INCAL st CP8, 50°15' N, 13°14' W, 2644 m, 1 sh; st WS1, 50°19' N, 13°07' W, 2550 m, 1 sh; DISCOVERY st 10112#2, 50°25' N, 13°20' W, 2640-2650 m, 1 sh; st 51611, 50°17' N, 13°24' W, 2640-2700 m, 1 sh; st 50613#1, 50°29' N, 13°02' W, 2440 m, 1 spm, 2 shs; THALASSA st X333, 44°10' N, 04°32' W, 1900-1950 m, 2 shs; NORATLANTE st B15, 44°07' N, 04°09' W, 1884-1911 m, 1 sh; st B19, 47°29' N, 08°24' W, 2149-2047 m, 1 sh.

-Northeastern Atlantic south of Biscay. --TALISMAN dr 38, 30°09' N, 11°41' W, 2210 m, 2 shs, 1 fragm; dr 42, 29°58' N, 11°41' W, 2104 m, 1 spm juv.; dr 45, 29°08' N, 12°26' W, 1235 m, 2 shs; dr 76, 25°01' N, 16°55' W, 2518-2638 m, 1 sh; dr 78, 23°57' N, 17°12' W, 1400-1435 m, 1 sh; dr 101, 16°38' N, 18°24' W,, 3200 m, 1 spm; dr 102, 15°48' N, 22°23' W, 3655 m, 1 spm, 2 shs; TALISMAN, "Soudan", 1 sh; MONACO Exp st 1116, 31°43' N, 10°47' W, 2165 m, 1 fragm (MOM); st 1150, 16°12' N, 24°44' W, 3890 m, 1 spm (IRSN); SEAMOUNT st DW 116, 42°52' N, 11°51' W, 985-1000 m, 1 larval sh (SMNH); NORATLANTE st B12, 36°21' N, 08°43' W, 2875 m, 4 spms; BALGIM st CP68, 35°12' N, 07°53' W, 1998-2077 m, 1 sh; st CP95, 34°24' N, 07°39' W, 1378 m, 2 shs; st CP106, 36°05' N, 08°05' W, 1898-1909 m, 1 spm.

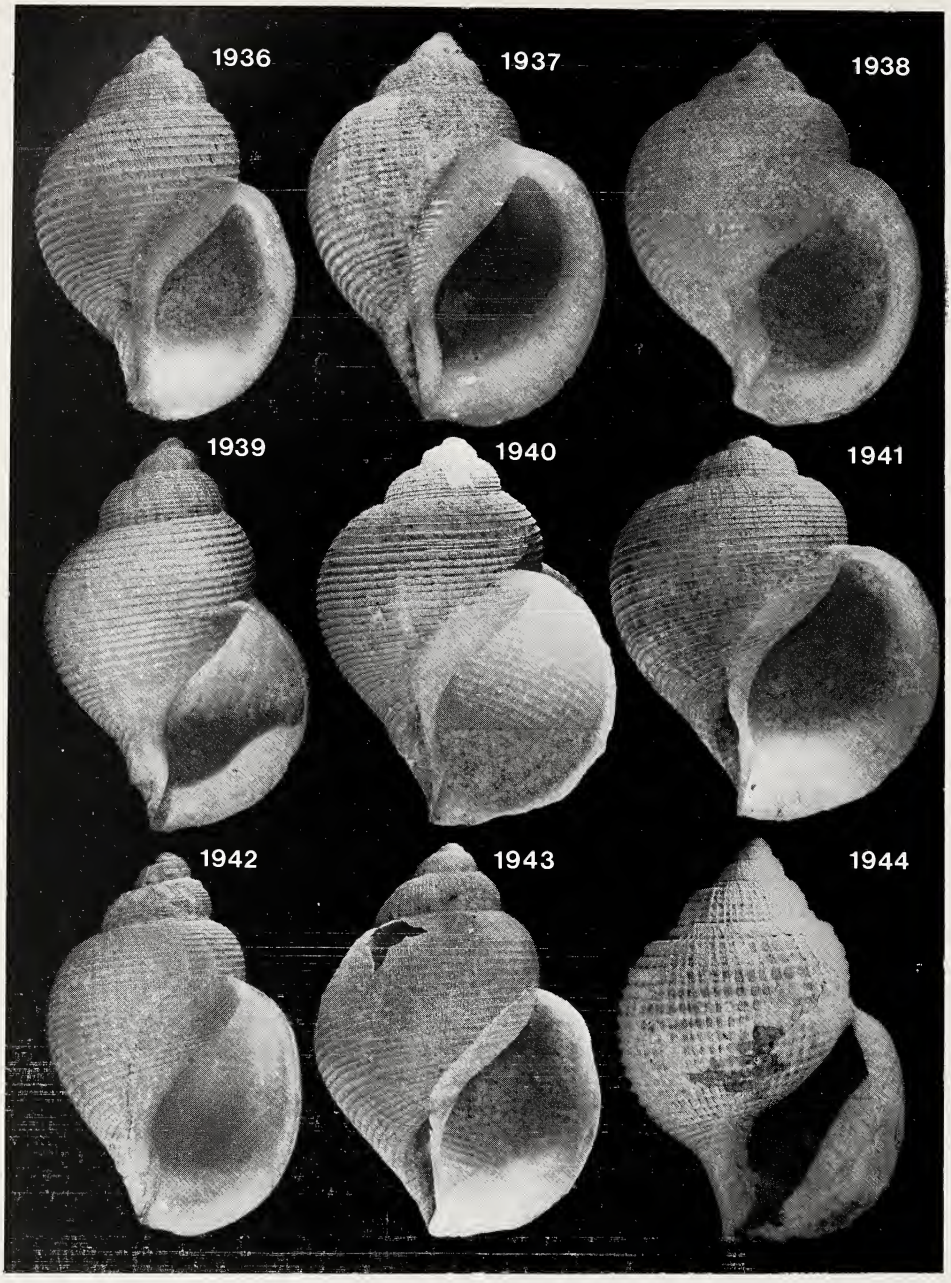
-Northwestern Atlantic and Caribbean. 48 lots with a total of 147 spms and shells (USNM, IRCZM, MNHN), in 338-5062 m.

-Northeastern South America. --BIOVEMA st CP2, 11°00' N, 45°14' W, 5073 m, 1 sh; DEMERABY st CP2, 08°07' N, 49°02' W, 4420 m, 2 spms; st CP3, 08°10' N, 49°04' W, 4430 m, 6 spms; st CP4, 08°11' N, 49°03' W, 4440 m, 1 spm; st CP5, 08°08' N, 49°02' W, 4434 m, 2 spms; st CP6, 08°09' N, 49°02' W, 4450 m, 2 spms; st CP9, 10°24' N, 46°47' W, 4850 m, 1 spm; st CP12, 10°21' N, 46°48' W, 4830 m, 1 spm; st CP14, 10°24' N, 46°46' W, 4830 m, 1 spm; st CP15, 10°24' N, 46°46' W, 4850 m, 1 spm.

-South Atlantic. --WALDA st CY5, 21°46' S, 11°08' E, 2953 m, 4 spms; st CY14, 12°21' S, 11°03' E, 3431 m, 2 spms, 3 shs; st CY20, 02°40' S, 05°43' E, 4088 m, 1 spm, 1 sh; WALVIS st CP12, 27°38' S, 00°51' E, 4660 m, 1 spm; st CP14, 32°29' S, 13°24' E, 3675 m, 1 spm; MARION-DUFRESNE cruise 55, st CP68, 18°56' S, 37°49'W, 1200-1500 m, 3 shs; 34°05' S, 16°58' E, 2675-2712 m, 14 shs (SAM A9843); off South Africa, 5 shs (SAM A9867).

-Indian Ocean. --BENTHEDI st 90, 11°44' S, 47°30' E, 3700 m, 1 spm; SAFARI 2 st CP2, 05°42' N, 78°56' E, 3625 m, 1 sh; MARION-DUFRESNE cruise 32, st CP105, 20°47' S, 55°04' E, 1740-1850 m, 1 sh; 22°17' S, 42°56' E, 1200 m, 1 sh.

-Southwest Pacific. --BIOCAL st CP30, 23°09' S, 166°41' E, 1140 m, 1 sh; st CP62, 24°19' S, 167°49' E, 1395-1410 m, 1 worn sh; st CP72, 22°10' S, 167°33' E, 2100-2110 m, 1 spm, 1 sh; BIOGEOCAL st CP260, 21°00' S, 166°58' E, 1820-1980 m, 1 sh; st CP272, 21°00' S, 166°57' E, 1615-1710 m, 1 sh; st CP317, 20°48' S, 166°53' E, 1620-1630 m, 1 sh; st CP341, 21°30' S, 167°47' E, 2334 m, 1 spm; RV TANGAROA st U223, 32°59' S, 152°42' E, 951-1150 m, 3 shs (AMS C155963); RV KAPALA, 32°53' S, 152°48' E, 1090-1134 m, 1 sh (AMS C158724); RV SOELA, 41°39' S, 148°42' E, 940-990 m, 1 sh (AMS C156076); RV FRANKLIN, 34°57' S, 151°29' E, 1650-1750 m, 3 shs (NMV).



Figures 1936-1944. Genus *Oocorys*. **1936-1943,** *Oocorys sulcata*. **1936**, BIOGAS st 1, 42.5 mm. **1937**, Gulf of Mexico, 27°14' N, 89°37' W, 2085-2063 m, height 28 mm. **1938**, BIACORES st 180, 25 mm. **1939**, BIACORES st 163, 42.5 mm. **1940**, WALDA st CY14, 48.6 mm. **1941**, WALDA st CY14, 43 mm. **1942**, holotype of *O. watsoni*, 27 mm. **1943**, DEMERABY st CP6, 45 mm. **1944**, *O. cancellata*, MONACO Exp st 719, 37.6 mm.

Distribution: From southwest of Ireland and off New England southwards, to the Azores, the Caribbean and the Gulf of Mexico (Bayer 1971, Quinn 1980, and material in USNM), off western and southwestern Africa (Bayer 1971 and material in MNHN), and off northeastern Brazil (material in MNHN). Outside the Atlantic, *O. sulcata* has been recorded from off southern Africa (Kilburn 1975), the Indian Ocean (Smith 1906, and material listed above), from Indonesia (Schepman 1909) and the southwestern Pacific. It is a bathyal and abyssal species. The deepest records are 5062 m in the Caribbean Sea and 5073 m in the Vema Fracture Zone (Mid-Atlantic), and there are repeated occurences in 350-500 m in the Caribbean and the Gulf of Guinea. Off Europe however it never occurs more shallow than 1000 m.

Remarks: The distribution and continuous transition between morphs leave no doubt that a single somewhat variable species is involved in our concept of *O. sulcata*. The nominate form (Fig. 1938) is small and stout, with a thick outer lip, and occurs in 1000-2500 m. (Specimens labelled *fischeri* by Locard are indistinguishable from typical *sulcata*.) Specimens from deeper water (Figs 1940-1) are larger, the shell is lighter, and have a reflected but thin outer lip. This is the form called *abyssorum* which, in the eastern Atlantic dominates at a depth of 3000-4500 m. In the western Atlantic the variation is similar, with solid, small specimens as shallow as 338 m, and the larger, thin-shelled *abyssorum* form in deep water. In the southwestern Atlantic, abyssal specimens have a taller spire than in the northwestern Atlantic, and have a very fragile shell. Specimens called *"watsoni"* (Figs 1942-3) have a moderately light shell but otherwise correspond more or less to that tall spired form. The form described as *O. umbilicata* (Fig. 1937) has an umbilicus, like *abyssorum*, and is as solid and heavy as *sulcata*, but can not be separated.

Three other names introduced for specimens of *Oocorys* from the Indian Ocean may be synonyms: *O. sulcata* var. *indica* Smith, 1906, *O. weberi* Schepman, 1909 and *O. schepmani* Turner, 1948. We have, however, not examined the type material.

The protoconch is multispiral, with reticulate sculpture, and planktotrophic larval development can be inferred. It resembles that of *Laubierina*, but is smaller, with lower spire, and raised spiral cords extending into the umbilical region (Figs 1920, 1922).

None of the shells labelled *fischeri* by Locard in MNHN match his drawing, which may be composite. We have designated a lectotype, which is 37 mm high while Locard gave a height of 35 mm.

Oocorys cancellata Dautzenberg & Fischer, 1897 Figs 1930, 1944

Oocorys sulcata var. *cancellata* Dautzenberg & H. Fischer, 1897:162; Dautzenberg 1927:144.
Oocorys sulcata caribbaea Clench & Aguayo, 1939:192, pl. 29 fig. 3.

Type materials: O. s. var. *cancellata*, lectotype here selected, the shell from MONACO Exp st 703, in MOM; *O. s. caribbaea*, holotype MCZ 135072.

Type localities: O. s. var. *cancellata*, MONACO Exp st 703, 39°21' N, 31°06' W, 1360 m; *O. s. caribbaea*, ATLANTIS st 2953, 21°47' N, 84°32' W, 1130 m, off Cuba.

Material examined: The lectotype of *O. cancellata* and MONACO Exp st 719, 39°11' N, 29°06' W, 1600 m, 2 shs (MOM, IRSN); BLAKE st 11, 19°06' N, 74°49' W, 2196 m, 1 sh (USNM 581937); 23°51' N, 75°51' W, 1853 m, 2 shs (USNM 824127); 24°32' N, 76°30' W, 1683 m, 1 sh (USNM 824090); 23°51' N, 75°50' W, 1853 m, 1 sh (USNM 824157); 22°54' N, 75°16' W, 2443 m, 1 sh (USNM 824151); --22°34' N, 75°35' W, 2553 m, 1 sh (USNM 824143); --24°14' N, 76°06' W, 1778-1788 m, 6 shs (USNM 824085).

Distribution: The northern part of the Caribbean in 1100-3300 m (Turner 1948, Quinn 1980), and the Azores where it probably is fossil (see discussion below).

Remarks: Although introduced as a varietal name, the name *cancellata* is available according to ICZN art.13, because it has been used before 1985 in subspecific or specific combinations. Dautzenberg (1927) raised the possibility that this was a distinct species that he would call *Oocorys cancellata*, and Turner (1948) suspected *"O. sulcata cancellata"* to be very close to *O. caribbaea* but regretted it had never been figured. We therefore consider *O. cancellata* to be the valid name for the species known as *O. caribbaea* in the American literature.

The three shells recorded from the Azores are old with a black coating (Fig. 1944, coated with ammonium-chloride), probably as a result of precipitation of manganese oxides as is common in Mediterranean deep-sea corals of Würmian age. It is remarkable that only these three shells have been collected in the Azores in 100 years, despite numerous dredgings that have yielded many *O. sulcata*. We therefore suspect that these shells originate from a fossil (pseudo-)population that temporarily became established. The protoconch is multispiral with reticulate sculpture (Quinn 1980 and Fig. 1930), and indicates planktotrophic larval development. Larvae drifting in the North Atlantic drift would enable colonization of the Azores and explain such a discontinuous distribution.

Genus *GALEODEA* Link, 1807

Galeodea Link, 1807:113. Type species, by monotypy, *Galeodea echinophora*. Europe.
Morio Montfort, 1810:479. Type species, by monotypy, *Buccinum echinophorum* Linné, 1758. Europe.
Echinora Schumacher, 1817:249. Type species, by monotypy, *Echinora tuberculosa* Schumacher, 1817 (=*Buccinum echinophorum* Linné, 1758). Europe.
Echinophora Latreille, 1825:194. (emendation of *Echinora* Schumacher?).
Cassidaria Lamarck, 1816:3. Type species, by subsequent designation (Woodward 1851:115), *Cassidaria echinophora*.

Remarks:
History of the generic name: During most of the 19th century, the European species *Buccinum echinophorum* and *B. tyrrhenum* were classified in *Cassidaria* Lamarck, although Herrmannssen (1846, 1852) recognized *Galeodea* and *Morio* to be older. Woodward's (1851) designation of *Cassidaria echinophora* as genotype supersedes that of *C. striata* Lamarck, 1816 by Bucquoy, Dautzenberg & Dollfus (1882:68).

Wenz (1941:1047) believed *Galeodea* Link, 1807 to be preoccupied by "*Galeodea* Olivier, 1791". Olivier, however, introduced *Galeodes*, not *Galeodea*.

When introducing the genus *Morio*, Montfort (1810) included several different species under the name *Morio echinophorus*, among them an Eocene fossil from the Paris basin, about which he wrote: "We have found it fossil in Grignon; ..... it is this fossil which we have depicted in natural size in the figure we use as type" (translated). This may be a valid type designation although it is not clear which Eocene species Montfort exactly had before him. This should not create any practical problem since it is undoubtedly a species of *Galeodea* (J. LeRenard, pers. comm.).

When introducing *Echinora* and *E. tuberculosa*, Schumacher referred to "*Buccinum Echinophorum* Lin. *Cassis ventricosa, echinophora* Martin. 2 pag.86. Tab.41 fig. 407.408". *Echinora* and *E. tuberculosa* are thus objective synonyms of *Galeodea* and *G. echinophora*. This explains why Schumacher introduced a new specific name, and also implies that *"Echinora"* is a misspelling of *Echinophora* since in those days tautonymy was not allowed.

There are numerous other generic names based on Tertiary fossils in Europe and North America which have been, at one time or another, considered synonyms of *Cassidaria* or *Galeodea*. We have considered it beyond the scope of this paper to discuss these names. These are, however, younger and will not interfere with *Galeodea*.

European species. Beside the type species of *Galeodea*, also *G. echinophora* lives on muddy bottoms on the Mediterranean continental shelves where it forms locally abundant populations. The vertical distribution is surprisingly poorly documented because most museum material originates from commercial fishing boats and has unprecise data. The horizontal distribution extends over most (all?) of the Mediterranean with a western limit at Alger on the African side (Pallary 1900). There are records from southwestern Spain (Hildalgo 1917) and Portugal (Nobre 1940), but we have seen no recently collected specimens, and consider the records doubtful. The two species of *Galeodea* thus coexist only in the western Mediterranean.

Larval shell. The two Mediterranean species of *Galeodea* have intracapsular larval development (Hughes 1986) and hatch in the crawling stage. Such young specimens have been identified from Recent and Pleistocene sediments of the Tyrrhenian area by Bogi *et al.* (1982), Cecalupo (1986) and Rindone (1990) as *Entoconcha mirabilis*. Their identification is based on a figure in Vatova (1978), showing a veliger of *Entoconcha*. The larval shell of that specimen has a diameter of 210 μm. The authors, however, described and figured shells of a diameter of 1.1-1.25 mm (Fig. 1923). This discrepancy was noticed by Bogi *et al.* but did not alarm them. We consider their records to be based on protoconchs of *Galeodea* (Figs 1923, 1931).

Galeodea rugosa (Linné, 1771) Figs 1945-1947

Buccinum rugosum Linné, 1771:549.
Buccinum tyrrhenum Gmelin, 1791:3478.
Morio tyrrhena var. *globosior* Coen,1920:135, pl. 6 fig. 2.
Cassidaria tyrrhena atlantica, carenata, dentata, elongata, major, minor, soluta and varicosa, all Settepassi, 1970:xviii-xix (Some names are erroneously credited to Monterosato or Philippi).

Type materials: B. rugosum, lectotype, here selected, the shell in the collection of the Linnean Society of London (examined by S. Gofas, pers. comm.); *B. tyrrhenum*, lectotype, here selected, the shell figured by Chemnitz (1788:figs 1461-1462) and referred to by Gmelin, in ZMC.

Type localities: B. rugosum, none; *B. tyrrhenum*, 'in Mari Tyrrheno'.

Material examined: 75 lots with 152 spms and shells.
-Off the British Isles. Northernmost records (all MNHN, leg. von Cosel) --PROCELT 2 st L235, 53°11' N, 14°24' W, 265-270 m, 1 sh; st L243, 53°15' N, 13°05' W, 262-273 m, 2 spms, 5 shs; st L245, 53°24' N, 12°36' W, 319-320 m, 1 sh; st L247, 53°13' N, 12°31' W, 353 m, 1 sh; 11 lots (6 spms, 13 shs) between 52 and 53°N, 217-605 m; 5 lots (2 spms, 8 shs) between 51 and 52°N, 460-790 m; 3 lots (10 spms) between 50 and 51°N, 603-705 m.
-Bay of Biscay. --23 lots (23 spms, 16 shs) with good data, in 290-1000 m; 8 lots (5 spms, 8 shs) from old collections with less precise data.
-West of the Iberian peninsula. --3 lots (3 shs) in 627-800 m.
-Ibero-Moroccan Gulf. --8 lots (2 spms, 16 shs) with good data, in 178-724 m.
-Western Mediterranean. --7 lots (1 spm, 7 shs) with good data, in 354-670 m; 8 lots (1 spm, 12 shs) from old collections with unprecise data.
-Off NW Africa. --BALGIM st CP89, 34°20' N, 07°18' W, 719-724 m, 1 sh; VANNEAU st 43, 33°51' N, 07°47' W, 133 m, 1 sh; TALISMAN dr 18, 33°33' N, 08°59' W, 550 m, 2 shs; dr 33, 32°29' N, 09°47' W, 896-1350 m, 1 sh; 1 mixed lot from dr 33, 62 and 86, 4 spms.

Distribution: From west of Ireland (earlier records discussed by O'Riordan 1985), along the continental slope as far south as southern Morocco, in 150-1000 m, usually 300-700 m. Southernmost record 22°52' N (TALISMAN dr 85, Locard 1897).

In the Mediterranean, *G. rugosa* lives on the muddy bottoms of the deep continental shelf and

the upper bathyal part of the western basin. The vertical distribution there is not precisely known, with most records simply stating "deep water".

Remarks: There are no less than 85 subspecific or infrasubspecific names of *Galeodea* listed by Settepassi (1970), most of which are based on individual variations of Recent and fossil specimens of *G. echinophora*. Recent deep-water specimens have, however, been given remarkably few names, which are listed in the synonymy. (We suspected the name *Morio cylindrica* Coen, 1920 to represent a variation of *G. rugosa*, but examination of the holotype (HUJ 23333) proved it to be a smooth form of *G. echinophora*.)

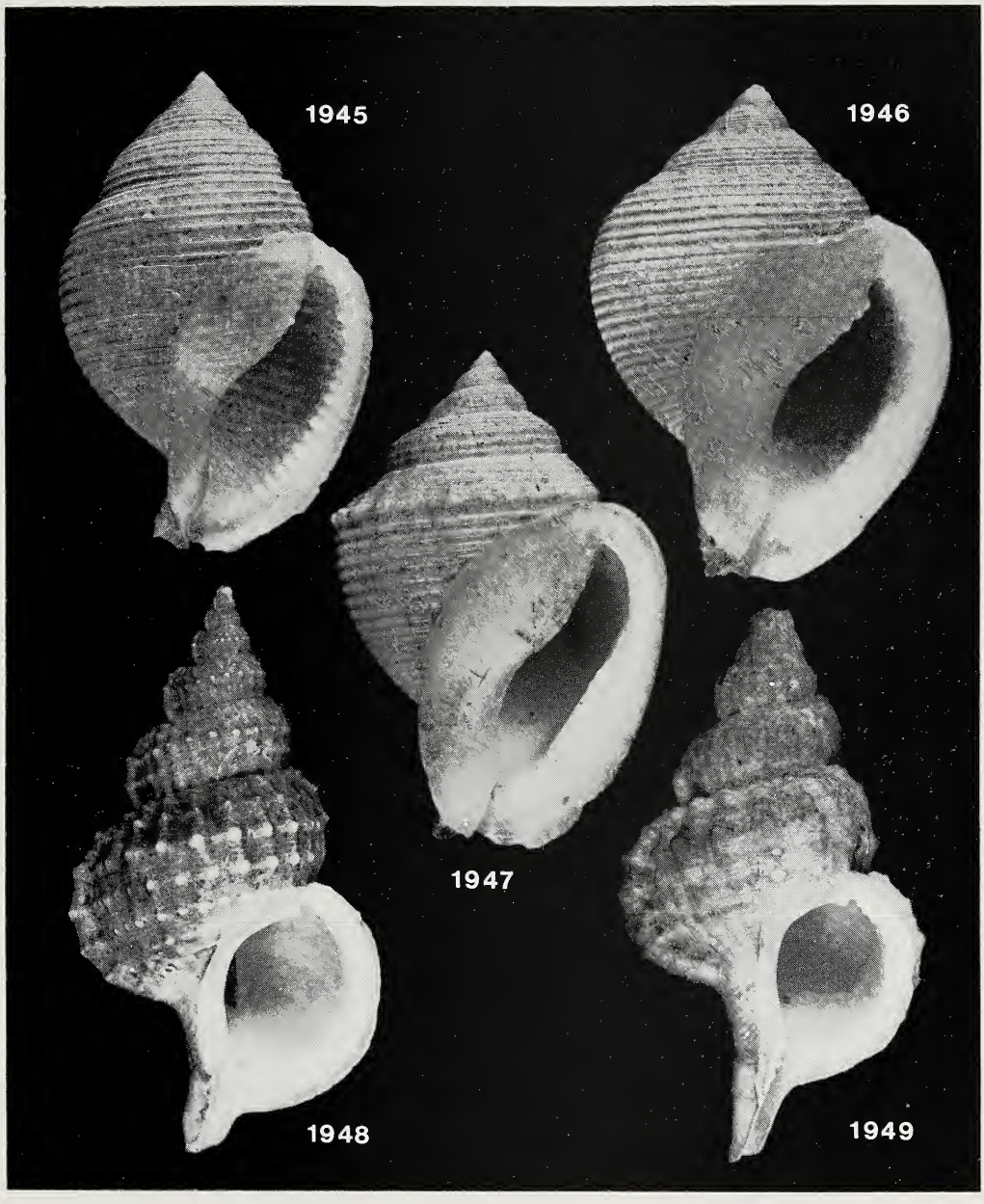
Diverging opinions have been expressed in the literature on the identity of *Buccinum rugosum* Linné, 1771. Hanley (1855:456), based on a shell in the Linnean collection in London, considered it an older name for *Galeodea tyrrhena*, and his opinion was repeated by Dodge (1956:234). Conversely, Tiberi (1863:150) regarded *B. rugosum* as a form of *G. echinophora* with a single row of nodules. Confusion also arose from Deshayes (1844:8) who treated *rugosum* as synonym of *tyrrhena* and believed *tyrrhena* to be a variation of *echinophora*. With or without justifying their choice, European authors have later indifferently used *rugosa* or *tyrrhena* for the deep-water specimens of *Galeodea*. S. Gofas has examined the only remaining syntype of *G. rugosa*, which we have selected as lectotype of *B. rugosum*. It agrees perfectly with the accepted concept of *tyrrhena*.

Galeodea rugosa is less variable than *G. echinophora*, but nevertheless it varies enough to cause confusion. Most specimens have a light shell, with a high spire and very even spiral sculpture (Fig. 1945), but scattered specimens in the same popoulation may have a heavy, thick shell and low spire (Fig. 1946). Specimens may also develop an undulating keel on the shoulder of the body-whorl, forming indistinct nodules, but the general morphology of the shell and the spiral sculpture are otherwise normal (Fig. 1947). This variation, which had been noticed by Monterosato (1890:184), corresponds to the lectotype and is particularly common in the easternmost part of the Ibero-Moroccan Gulf.

Much discussion is to be found in the literature on the status of the specimens of *Galeodea* which lack tubercles and are common, also in shallow water, in the Adriatic. Sabelli & Spada (1978) figured this form, which has generally been considered to belong to *echinophora* (form *"mutica"*), a conclusion with which we agree since we have seen many intermediate specimens that exist, also apparently in the same populations.

Galeodea rugosa has not been reliably recorded from the eastern Mediterranean but specimens are said to have been taken in the Ionian sea by fishing boats operating from Siracusa, eastern Sicily (A. Giudice, pers. comm.). We consider, however, that this occurrence needs to be confirmed. Panetta (1970:159) reported young specimens from the Golfo di Taranto, southern Italy, but this record was later excluded without comments (Panetta 1971, Di Geronimo & Panetta 1973).

The anatomy of *G. tyrrhena* was described by Reynell (1905, 1906).



Figures 1945-1949. Genera *Galeodea* and *Ranella*. **1945-1947,** *Galeodea rugosa*. **1945**, PROCELT st K210, 49°46' N, 11°13' W, 630-632 m, 105 mm. **1946**, THALASSA st X366, 44°07' N, 04°50' W, 710-725 m, 60 mm. **1947**, Tanger, Morocco, 83 mm. **1948-1949**, *Ranella olearia*. **1948**, PROCELT st K230, 48°08' N, 08°23' W, 354-368 m, 150 mm. **1949**, BIACORES st 239, 3729' N, 2545' W, 628-646 m, 75 mm.

APPENDIX: COMMENTS ON SPECIES MISIDENTIFIED OR ERRONEOUSLY ASSIGNED TO THE DEEP-SEA FAUNA

There are several names of supposed deep-sea species of caenogastropods which have proved to belong to the shallow-water fauna or are based on misidentifications. These are listed here and commented.

RISSOIDAE

Alvania fischeri (Jeffreys, 1884) (Figs 1390-1391, 1399) was figured by van Aartsen *et al.* (1984) from shallow water in southern Spain. We have examined the type material and agree that it belongs to the shallow water fauna, although Jeffreys described it from deep water.

Alvania laxa (Dautzenberg & Fischer, 1896) was described from deep water in the Azores and was discussed by Gofas (1990:104) and considered a synonym of *Alvania cancellata* (Da Costa, 1778). We have examined the type material and agree.

Alvania parvula (Jeffreys, 1884) was described from deep water south of Portugal and was discussed by Gofas & Warén (1982) who concluded it to belong to the shallow water fauna. Later field work in northern Morocco and southern Portugal has proved this to be correct.

Hela glabella Monterosato, 1875:25 (*nom. nud.*); Monterosato, 1878:83 (*nom. nud.*); Monterosato, 1880:67 was described from Sicily, between Palermo and Ustica, 300 m, with the words: "Differs [from *Benthonella tenella*] by its more globular shape and by the absence of the spiral lines of periphery, from the young of tenella. The incremental lines are more oblique and conspicuous and the umbilicus is more narrow". Monterosato never mentioned it again.

Despite thorough search in ZMR, no possible types were found. A tube which, according to the label, once may have contained the type, contained a single immature *Rissoa similis*, which certainly not is the species described by Monterosato. We consider this a *nomen dubium*.

Onoba moreleti Dautzenberg, 1889:52. Moolenbeek & Hoenselaar (1987) discussed this species and suspected it to be a shallow water species, despite the types originating from 1287 m depth among the Azores. The shallow-water habitat of this species was confirmed by Gofas (1990:125).

Rissoa angulata Jeffreys, 1884:119 was described from Adventure Bank in the Sicily Channel, and was renamed *Turboella (Turboella) ehrenbergi gwyni* Nordsieck, 1982:112. We have examined the holotype (BMNH 1885.11.5.1758), and it is based on an unrecognizable, fragmentary apex of a species of *Rissoa* or *Pusillina*.

Rissoa griegi Friele, 1879:274 was described from west of Spitsbergen, 2400 m. Warén (1989) has shown that this is a junior synonym of *Obtusella tumidula* (G.O. Sars, 1878), an arctic shallow water species. To these two names can also be added *Punctulum minutum* Golikov & Fedjakov in Scarlato, 1987:82, described from the White Sea and an unquestionable synonym.

Rissoa jousseaumei Dautzenberg & Fischer, 1896:454, was described from deep water among the Azores, and discussed by Gofas (1990:99) who concluded it to be a junior synonym of *Rissoa guernei* Dautzenberg, 1889, a shallow water species. We have examined the type material and agree.

Rissoa obesula Dautzenberg, 1889:48 was described from deep water among the Azores, and was discussed by Gofas (1990:99), who concluded it to be a junior synonym of *Rissoa guernei* Dautzenberg, 1889. We have also examined the types and agree.

Rissoa poucheti and var. *cingulifera* Dautzenberg, 1889:49 was discussed by Gofas (1990:108) and considered a shallow water species. We have examined the types and agree.

Rissoa (Setia) quisquiliarum Watson, 1886:609 (Fig. 1569) was described from deep water in the Azores, and recorded by Nordsieck (1982) from 15 m depth at Sao Miguel. The identity of this record was confirmed by Gofas (1990). Gofas has now (pers. comm.) examined specimens from shallow water in Terceira (the Azores). It is the type species of *Varisetia* Nordsieck, 1972.

Rissoa turricula Jeffreys, 1884 was renamed *Rissoa consociata* de Gregorio, 1885:168 and *Pusillina turrita* Monterosato, 1890:146. We have examined the types from PORCUPINE Exp 1870 st 3, 48°31' N, 10°03' W, 1256 m, 2 syntypes (BMNH 1885.11.5.1777-8) and 4 shs (coll. Sykes, BMNH), from the same locality. There is also material from PORCUPINE Exp 1870 st 30, 36°15' N, 06°52' W, 703 m, 1 sh (coll. Sykes, BMNH). These are old shells of a rissoid with planktotrophic development, and which have lost the outer layer of the shell by corrosion. They probably represent specimens of some of the western European shallow water species of *Rissoa*, which have been carried out to deep water by drifting seaweed.

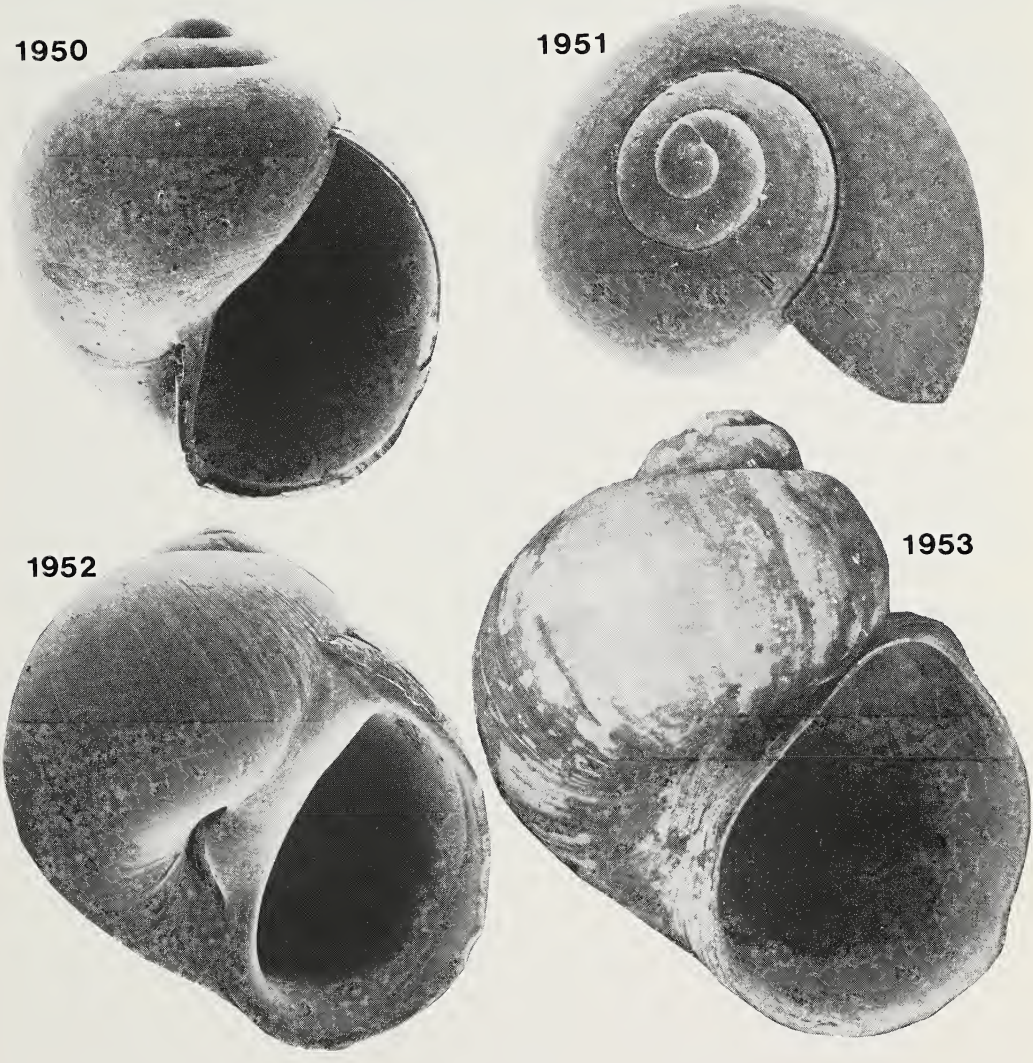
OMALOGYRIDAE

Several species of Omalogyridae have been described from deep water by Jeffreys (1884), Sykes (1925) and Palazzi (1988). We have examined specimens with soft parts of most of them, except *Homalogyra marshalli* Sykes, 1925. With the exception of the last mentioned species, all seem to be archaeogastropods or heterobranchs and will be treated in parts 5 and 6 of this series. Of *H. marshalli* we have seen only the holotype, which is in poor condition, but B. Marshall (NMNZ) sent us a shell in good condition of a species from New Zealand which we cannot distinguish from Sykes' species. Judging from the shape of the larval shell, its connection to the teleoconch and the oblique aperture with a slightly flaring outer lip, this may be a species of *Discaclis* Moolenbeek & Warén, 1988, although it has admittedly less aclid appearance than the type species of that, so far monotypic, genus.

MISCELLANEOUS

Natica globosa Jeffreys, 1885:33, pl. 4 figs 4-4a. (Not *Natica globosa* Grateloup, 1828 and several other authors.) This species has been listed in Mediterranean checklists as *Bulbus globosus* (e.g. Bogi 1987:238; Villa 1986:18; Sabelli et al. 1990). We have examined several syntypes, USNM 188530, BMNH 1885.11.5.2407-08, 2322-2324, 2344, from off southwestern Europe and the Mediterranean, depth 700-2000 m. We figure one of the best preserved specimens (Figs 1950-1), which is here selected as lectotype. The name is based on a mixture of larval shells, mainly cassids and a few bursids. The lectotype is a larval shell of *Semicassis*. From a nomenclatorial point of view, this does not have any consequences since Mediterranean cassid names are much older than *Natica globosa*.

Natica nana Möller, 1842. Jeffreys (1885:34) and Locard (1896:162; 1897:475) have recorded this high-Arctic shallow water species from the British Isles, the Bay of Biscay, and off Northwest Africa in deep water. We have examined: --PORCUPINE Exp 1869, the Minch, 109-146 m, 2 shs (USNM 189939), det. *N. nana* by Jeffreys, belong to *Polinices pulchella* (Risso); --TALISMAN 1883 (dr 71 & 90?), ca. 20-25°N, 2 shs (MNHN), det. *N. nana* by Locard, are *Tectonatica rizzae*; --



Figures 1950-1953. **1950-1,** *Natica globosa*, syntype, Bay of Biscay, USNM 188530, height 1.9 mm, diameter 1.8 mm. **1952,** *Polinices nanus*, Davis Strait, Greenland, 5.5 mm. **1953,** *Choristes elegans*, syntype, USNM, 17 mm.

Bay of Biscay, 1 spm (coll. Locard, MNHN), det. *N. nana*, presumably the record from "Golfe de Gascogne, 1710 m", published by Locard (1896:162), is *Polinices obtusa* (Jeffreys). Fig. 1952 shows an arctic specimen of *Polinices nanus* Möller, 1842.

Adeorbis umbilicatus Locard, 1898:11, pl. 2 figs 1-4 (Jeffreys, 1880:375 [*nom. nud.*], DeFolin 1882:143 [*nom. nud.*]). We have examined the holotype in MNHN, from TRAVAILLEUR Exp 1880, dr 14-15, 43°47' N, 02°06' W, 677-813 m. This is a species related to the archaeogastropod genus *Trenchia* Knudsen, 1964, and will be treated in part five of this series.

Lamellaria tenuis Jeffreys, 1885:45, was described from deep water off Portugal. We have examined the types (BMNH 85.11.5.2602-3, 2605-6), which are not based on a lamellarid, but seemingly on some juvenile, unrecognisable specimens of *Sinum* (Naticidae) or a cephalaspid.

Cithna olivacea Verrill, 1884:185, pl. 29 fig. 5 (Fig. 1925) was described from off New England in 353-2360 m. We have examined the holotype (USNM 38237) and found it to be the larval shell of a species of *Tonna*. Along the eastern coast of North America, *Tonna galea* (Linné, 1758) is known as far north as North Carolina (Turner 1948), and *Cithna olivacea* is very likely the larva of that species.

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LAUBIERINIDAE Warén & Bouchet, 1990 790
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Lovenella G.O. Sars, 1878 = Cerithiella 588
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major Settepassi, 1970 (Cassidaria tyrrhena) = rugosa 805
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Mayena Iredale, 1917 = Ranella 793
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minor Philippi, 1851 (Natica clausa var.) = affinis 763
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minor Locard, 1897 (Natica olivella var.) = subplicata 783
minor Locard, 1897 (Oocorys sulcata var.) = sulcata 800
minor Locard, 1897 (Oocorys fischeri var.) = sulcata 800
minor Settepassi, 1970 (Cassidaria tyrrhena) = rugosa 805
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nana Möller, 1842 (Natica): Polinices 810
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Nawenia Ladd, 1977 = Pisanianura 792
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Newtoniella Cossmann, 1893 = Cerithiella 588
nitidum Forbes, 1847 (Cerithium) = metula 590
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nodosum Settepassi, 1970 (Argobuccinum giganteum var.) = olearia 793
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obesula Dautzenberg, 1889 (Rissoa) = guernei 810
obliqua Warén, 1974 (Alvania): Onoba 662
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obtusa Jeffreys, 1870 (Rissoa abyssicola var.) = electa 633
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olearium Linnaeus, 1758 (Murex): Ranella 793

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olivacea Verrill, 1884 (Cithna) = Tonna galea 812
olivella Locard, 1897 (Natica) = brassiculina 770
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ONOBA H. & A. Adams, 1852 659
OOCORYS Fischer, 1883 800
operculata Jeffreys, 1885 (Natica): Cryptonatica 759
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Ornitopus Piette, 1891: see under Aporrhais 708
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parivaricata de Gregorio, 1884 (Ranella reticularis var.) = olearia 793
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pommeraniae Dunker & Metzger, 1874 (Laiocochlis) = sinistrata 614
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Protomedea O.G. Costa, 1861 = Capulus 730
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pseudoareolata Warén, 1974 (Alvania) 641
PSEUDOSETIA Monterosato, 1884 685
pseudosyngenes Warén, 1973 (Alvania) 650
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Punctulum Jeffreys, 1884 = Alvania 652
pupoides Requien, 1848 (Rissoa) ?= proxima 703
pusilla Philippi, 1836 (Rissoa) = philippii 674
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quisquiliarum Watson, 1886 (Rissoa) 810

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RANELLIDAE Gray, 1854 792
rarituberculata Settepassi, 1970 (Argobuccinum giganteum var.) = olearia 793

RISSOIDAE Gray, 1847 623
rizzae Philippi, 1844 (Natica): Tectonatica 764
roseotincta Dautzenberg, 1889 (Setia): Obtusella 696
rugosum Linnaeus, 1771 (Buccinum): Galeodea 805
rutila MacGillivray, 1843 (Natica) = montagui 779

sarsii Kobelt, 1908 (Aporrhais pespelecani) = serresianus 708
Sasamocochlis Gründel, 1980 = Laiocochlis 614
scalaroides Warén, 1989 (Larsenia) 717
Schismospira Numanami & Okutani, 1990 = Torellia 732
sculpta Philippi, 1844 (Rissoa) = cimicoides 624
semipellucida Friele, 1879 (Rissoa): Pseudosetia 690
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settepassii Gaglini in Settepassi, 1985 (Natica) = rizzae 764
sicula Swainson, 1840 (Pedicularia) 749
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soluta Settepassi, 1970 (Cassidaria tyrrhena) = rugosa 805
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sphaeroides Jeffreys, 1877 (Natica): Amauropsis 772
spreta de Gregorio, 1885 (Rissoa) = vigoensis 649
squalida MacGillivray, 1843 (Natica) = montagui 779
squamaeformis Lamarck, 1803 (Patella): Leptonotis 712
stenolopha n.sp. (Alvania) 653
Stilus Jeffreys, 1885 = Cerithiella 588
striatissima de Rayneval, 1854 (Rissoa) = proxima 703
striatula Jeffreys, 1847 (Rissoa) = proxima 703
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sublaevigata Locard, 1897 (Pedicularia sicula var.) = sicula 749
subplicata Jeffreys, 1885 (Natica): Polinices 783
subsoluta Aradas, 1847 (Rissoa): Alvania 645
sulcata Fischer, 1883 (Oocorys) 800
Sulconatica Golikov & Kussakin, 1974 = Cryptonatica 758

TALASSIA Warén & Bouchet, 1988 714
Talisman de Folin, 1884 796
talismani n.sp. (Euspira) 767
tarsodes Watson, 1886 (Rissoa): Alvania 642
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tenella Jeffreys, 1869 (Lacuna): Benthonella 697
tenuis E.A. Smith, 1877 (Trichotropis) 737
tenuis Jeffreys, 1885 (Lamellaria): Sinum? 812
tenuis Coen, 1941 (Argobuccinum giganteum var.) = olearia 793
tenuisculpta (Watson, 1873) (Talassia) 717
testae Aradas & Maggiore, 1844 (Rissoa): Alvania 628
thalassae n.sp. (Frigidoalvania) 664
thompsoni McGinty, 1955 (Eudolium) = crosseanum 797
thorsoni Nordsieck, 1969 (Capulus hungaricus) = ungaricus 728
Thyreus Philippi, 1844 = Pedicularia 746
tiara Watson, 1886 (Cerithiopsis): Krachia 605

tiarella Verrill & Smith, 1882 (Torellia fimbriata var.) = delicata 732
tomentosa (Monterosato MS) Pallary, 1920 (Rissoa): Alvania 631
TONNIDAE Suter, 1913 (1825) 796
TORELLIA Jeffreys, 1867 732
Trachysma Jeffreys, 1874 = Torellia 732
tricarinata Jeffreys, 1885 (Seguenzia): Haloceras 724
Trichoconcha E.A. Smith, 1907 = Torellia 732
TRICHOTROPIS Broderip & Sowerby, 1829 737
TRIFORIDAE Jousseaume, 1884 617
TRIFORIS Deshayes, 1832 617
TRIPHORIDAE Gray, 1847 617
Tuberculodolium Sacco, 1891 797
turbonilloides Dautzenberg & Fischer, 1896 (Cerithiopsis): Ektonos 610
turgida Jeffreys, 1870 (Rissoa): Pseudosetia 691
turricula Jeffreys, 1884 (Rissoa): nomen dubium 810
turrita Monterosato, 1890 (Pusillina): nomen dubium 810
tyrrhenum Gmelin, 1790 (Buccinum) = rugosa 805

umbilicatus Locard, 1898 (Adeorbis) 812
umbilicata Quinn, 1980 (Oocorys) = sulcata 800
ungarica Linnaeus, 1758 (Patella): Capulus 728

valeriae Giusti, 1987 (Cerithiopsis): Onchodia 612
vanderlandi n.sp. (Gofasia) 668
VANIKORIDAE Gray, 1840 714
varicosa Settepassi, 1970 (Cassidaria tyrrhena) = rugosa 805
VELUTINIDAE Gray, 1840 737
ventricosa Locard, 1890 (Aporrhais serresianus var.) = serresianus 708
ventricosa Locard, 1897 (Natica montagui var.) = montagui 779
verduini van Aartsen, 1983 (Alvania) = vigoensis 649
verduini van Aartsen, Bogi & Giusti, 1989 (Laeviphitus) 704
verrilli Friele, 1886 (Rissoa): Alvania 651
versiliensis Warén, Carrozza & Rocchini, 1990 (Elachisina) = verduini 704
vestita Jeffreys, 1867 (Torellia) = delicata 732
VICINIRISSOA Ponder, 1985 678
vigoensis Rolan, 1983 (Onoba): Manzonia 649
vitreus Montagu, 1803 (Turbo): Hyala 701
vittata Jeffreys, 1877 (Natica affinis var.) = affinis 763

wareni Templado & Rolan, 1986 (Onoba): Alvania 648
watsoni Jeffreys, 1885 (Cerithium): Bittium 582
watsoni Locard, 1897 (Oocorys) = sulcata 800
wharekuriensis Laws, 1935 (Neojanacus) = perplexus 712
whiteavesii Verrill, 1880 (Lovenella) = metula 590
woodi Altena, 1954 (Laiocochlis) 615
wyvillethomsoni Friele, 1877 (Rissoa): Alvania 651

zetlandicus Montagu, 1815 (Turbo): Alvania 655
ZYGOCERAS Warén & Bouchet, 1991 726

Table 5. Distribution of the species.

The bathymetrical distribution is indicated in two ways, either by figures or lines. The heading indicates 100 metres intervals, and the figures the number of samples from the preceding interval. For some species of which numerous samples are known, a solid line indicates the normal distribution.
For latitudinal distributions, numbers in parentheses refer to the Western Atlantic part of the range; all other latitudes refer to the Eastern Atlantic range.
n is the number of samples examined. After the mean depth, the standard deviation is given. This gives some indication of the bathymetrical range.

Species	W. Arctic	E. Arctic	W. Atlantic	Europe	Mediterr.	Azores	Max °S	Max °N	Bathymetric distribution 3	5	10	15	20	25	30	35	40	45	50	n	Mean depth (m)	σ	Faunal assemblage
Bittium watsoni				*			15°N	43°N	6	9	17	2	1							36	579	336	upper bathyal
Cerithiella metula			*	*	?	*	28°N	73°N	——	——	27	16	10	10	11					200			shelf, bathyal
Cerithiella amblytera			*	*		*	20°S	39°N			2	14	4	1		2	1			26	1652	755	bathyal
Cerithiella enode			*	*			09°S	46°N			1					2	2	3	1	9	3710	993	abyssal
Cerithiella insignis				*			15°N	36°N	2	2	4	2								10	645	332	upper bathyal
Eumetula arctica	*	*	*	*			(42°)52°N	72°N	——	——	3	6	2							98			shelf, bathyal
Eumetula bouvieri				*		*	28°N	44°N		4	2	3	1							10	891	510	bathyal
Eumetula aliceae						*	39°N	39°N				1								1			bathyal
Ektonos turbonilloides				*		*	39°N	65°N			3	1	1	2						7	1865	651	bathyal
Krachia cossmanni				*		*	38°N	65°N	——	——		3	2							20			shelf, bathyal
Krachia obeliscoides				*		*	32°N	40°N				2	1							3	1874	249	bathyal
Krachia guernei						*	38°N	39°N		1	1	3								5	1053	347	bathyal
Onchodia valeriae				*	*		35°N	36°N	3	1	2									6	314	163	deep shelf
Laiocochlis sinistrata			*	*			56°N	71°N	——	——	——	4								35			shelf, bathyal
Cerithiopsis atalaya				*	*		07°S	48°N	——	——										10			shelf
Strobiligera brychia				*	*	*	28°N	49°N	8	18	16	5	1	1						49	590	411	shelf, bathyal
Strobiligera lubrica				*			48°N	48°N						1						1			bathyal
Strobiligera flammulata				*	*		36°N	37°N	2	2	1									5	314	183	shelf
Alvania cimicoides				*	*	*	28°N	71°N	——	——	——	13	2	1				2		300			shelf, bathyal
Alvania platycephala						*	37°N	39°N		1		3								4	1091	355	?
Alvania testae				*	*		42°N	63°N	——	——	22	5	1							132			shelf, bathyal
Alvania tomentosa				*	*		35°N	43°N	2	1	7									10	532	238	shelf, bathyal
Alvania dipacoi					*		28°N	44°N		1										1			upper bathyal

Species	W. Arctic	E. Arctic	W. Atlantic	Europe	Mediterr.	Azores	Max °S	Max °N	Bathymetric distribution 3	5	10	15	20	25	30	35	40	45	50	n	Mean depth (m)	σ	Faunal assemblage
Alvania electa				*	*		28°N	45°N			34	8	4	1						65			shelf, bathyal
Alvania porcupinae				*			28°N	49°N		7	9	11	4					1	1	33	1598	877	bathyal
Alvania adinogramma				*			36°N	37°N	1	6	3	1								10	489	213	shelf, bathyal
Alvania cancapae				*			28°N	33°N			4		1							5	883	544	bathyal
Alvania pseudoareolata	*		*				(41°N)	68°N	4		2									6	328	313	shelf, bathyal
Alvania jeffreysi				*			41°N	71°N			13	1	1							175			shelf, bathyal
Alvania tarsodes						*	37°N	40°N		1	4	1								6	857	268	?
Alvania subsoluta				*	*		28°N	71°N				15	5	4						228			shelf, bathyal
Alvania wareni				*			40°N	41°N			1		1							2	1310	500	bathyal
Alvania pseudosyngenes		*		*			65°N	71°N	1	3		2								6	604	438	shelf, bathyal
Alvania verrilli		*					70°N	77°N	1		1	1								3	631	417	bathyal
Alvania wyvillethomsoni		*		*			60°N	81°N	11	8	9	5	1	1	1					36	759	632	bathyal
Alvania adiaphoros						*	38°N	39°N		1	1									2	626	156	bathyal
Alvania stenolopha						*	39°N	39°N			1	1	1							3	1247	343	bathyal
Alvania lamellata						*	39°N	39°N				1											?
Onoba islandica				*			61°N	65°N	1	1	3									5	526	176	bathyal
Onoba leptalea	*		*	*			(42°)63°N	84°N	1	3	2		2							8	739	586	bathyal
Onoba obliqua	*	*	*	*			(64°)66°N	72°N	2	2	3									7	424	211	bathyal
Onoba gianninii					*		37°N	42°N	3											3	176	59	shelf
Frigidoalvania thalassae				*			43°N	49°N	1	2	9									12	618	170	bathyal
Manzonia zetlandica				*	*		28°N	68°N			11	2								90			shelf, bathyal
Crisilla amphiglypha							25°N	29°N			4									4	705	159	bathyal
Setia vanderlandi				*			30°N	35°N	1	2	2									5	444	194	bathyal
Setia galiciae				*			37°N	43°N			4	3								7	1007	264	bathyal
Setia josephinae				*			35°N	37°N	14	8	2	1		1						26	378	376	bathyal
Pusillina hadra							19°N	20°N										1		1			abyssal
Pusillina amblia				*			28°N	35°N				1	2	3						6	1858	286	bathyal

Species	W. Arctic	E. Arctic	W. Atlantic	Europe	Mediterr.	Azores	Max °S	Max °N	Bathymetric distribution												n	Mean depth (m)	σ	Faunal assemblage
									3	5	10	15	20	25	30	35	40	45	50					
Pusillina metivieri				*			28°N	37°N	1		3										4	518	256	bathyal
Vicinirissoa harpa			*				(43°N)	(50°N)	1	1											2	316		bathyal
Benthonellania gofasi							09°S	31°N	8	1			1								10	424	593	shelf
Benthonellania fayalensis						*	35°N	39°N			2	1									3	929	278	bathyal
Benthonellania oligostigma							33°N	33°N			1										1			bathyal
Benthonellania agastachys							28°N	28°N		1											1			bathyal
Pseudosetia amydralox				*			28°N	44°N	9	9	14	1	1								34	511	299	bathyal
Pseudosetia ficaratiensis				*			36°N	40°N	1	3	2		1								7	543	426	bathyal
Pseudosetia azorica						*	37°N	38°N		2	1										3	535	178	bathyal
Pseudosetia semipellucida				*			61°N	78°N			2		3	6	2						13	2506	784	abyssal
Pseudosetia turgida				*			48°N	72°N	—	—	7	2									60			shelf, bathyal
Obtusella intersecta				*	*		35°N	67°N	—	—	4										76			shelf, bathyal
Obtusella macilenta				*	*		35°N	49°N	15	3	3	1									22	295	287	shelf, bathyal
Obtusella roseotincta						*	39°N	39°N				1									1			?
Amphirissoa cyclostomoides						*	39°N	39°N					1								1			bathyal
Benthonella tenella			*	*	*	*	28°N	60°N	—	—	—	—	—	—	—	—	—	—	—		154			bathyal abyssal
Hyala vitrea				*	*		35°N	60°N	—	8		1									95			shelf, bathyal
Ceratia proxima				*	*		35°N	55°N	—	3	1	1									15			shelf, bathyal
Laeviphitus verduini					*		42°N	43°N													1			bathyal
Aporrhais serresiana				*	*		35°N	68°N	—	—	—	7							1		156			shelf, bathyal
Leptonotis perplexus				*			44°N				1	2	1	1	1						6	1612	673	bathyal
Talassia dagueneti				*	*		32°N	48°N	—	—	—	—									32			shelf, bathyal
Larsenia scalaroides				*			64°N	66°N	6	2	4										12	410	240	bathyal
Haloceras carinata			*	*			27°N	42°N			5	1	2	1							9	1192	512	bathyal
Haloceras cingulata			*	*			36°N	49°N				1	2	4	1						8	2018	494	bathyal
Haloceras laxa				*			37°N	49°N				3	1	3							7	1606	493	bathyal
Haloceras mediocostata						*	38°N	39°N				3									3	1303	98	bathyal
Haloceras tricarinata				*			32°S	40°N				1		2		3	1				7	2786	856	bathyal, abyssal

Species	W. Arctic	E. Arctic	W. Atlantic	Europe	Mediterr.	Azores	Max °S	Max °N	Bathymetric distribution 3	5	10	15	20	25	30	35	40	45	50	n	Mean depth (m)	σ	Faunal assemblage
Torellia delicata			*	*	*		(39°)36°N	68°N	10	20	8			2	15	1		1	2		59	1185	1165	shelf, bathyal
Torellia didyma				*			45°N	48°N						1					2		3	3999	1289	abyssal
Trichotropis bicarinata tenuis	*						67°N	77°N	9	4	1										14	236	158	shelf
Capulus ungaricus				*	*	*	00°	71°N			6	3	1	1							183			shelf
Capulus simplex				*		*	20°N?	64°N		1	3	2	1								7	983	542	bathyal
Pseudotorellia fragilis							65°N	67°N	4	1											5	188	64	shelf
Calyptoconcha pellucida			*	*		*	(37°)22°N	64°N	7	2	5			2	2			1			19	1022	1180	shelf, bathyal
Pedicularia sicula				*	*	*	27°N	49°N	4	2	12	2									20	536	301	bathyal
Cryptonatica bathybii		*		*			62°N	80°N	1		2	4	1	7	4						19	1760	869	abyssal
Cryptonatica operculata				*	*		35°N	49°N	10	8	13	3	1	2							37	610	470	bathyal
Cryptonatica affinis	*	*	*	*			47°N	84°N				3	2	1	1						80			shelf, bathyal
Tectonatica rizzae				*	*	*	25°N	44°N													20			shelf, bathyal
Euspira talismani				*			22°S	22°N			1	2			1						4	1546	826	bathyal
Euspira grossularia				*	*		15°S	36°N													31			shelf
Amauropsis brassiculina				*			19°N	44°N?			5	1	2	1	1						10	1356	716	bathyal
Amauropsis sphaeroides			*	*			21°N	59°N			1	1	1	4	8	1	2	10	4		32	3320	1109	bathyal, abyssal
Polinices fusca				*	*		15°S	58°N			42	5	1								170			shelf, bathyal
Polinices montagui				*			35°N	71°N			34	4	1	8	7				2		273			shelf
Polinices obtusa				*			19°N	64°N		1	4	10	12	21	21	1	1	1			72	2148	702	bathyal
Polinices subplicata				*			21°N	51°N	1	4	19	16	18	6				1			65	1333	674	bathyal
Polinices phaeocephala						*	36°N	39°N			1	5	6								12	1486	290	bathyal
Laubierina sp.A				*			(22°)28°N	38°N	2		1		2	2							7	1303	781	bathyal
Laubierina cf. peregrinator						*	37°N	38°N					1								1			bathyal
Oocorys sulcata			*	*			34°S	51°N			3	13	6	16	8	4	2	1			53	2118	779	bathyal
Galeodea rugosa				*	*		23°N	52°N			14	1									75			shelf
Eudolium crosseanum			*		*?																			shelf, bathyal
Eudolium bairdii			*	*		*	38°N														5			bathyal
Pisanianura grimaldii				*		*	39°N				2	1	2	1							6	1339	506	bathyal
Ranella olearia				*	*	*	15°N	52°N			13	1									71			shelf, bathyal

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